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AVIATION

The Oldest ... Magazine

AUG 15 1940

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AVIATION

Established 1916

THE OLDEST AMERICAN AERONAUTICAL MAGAZINE

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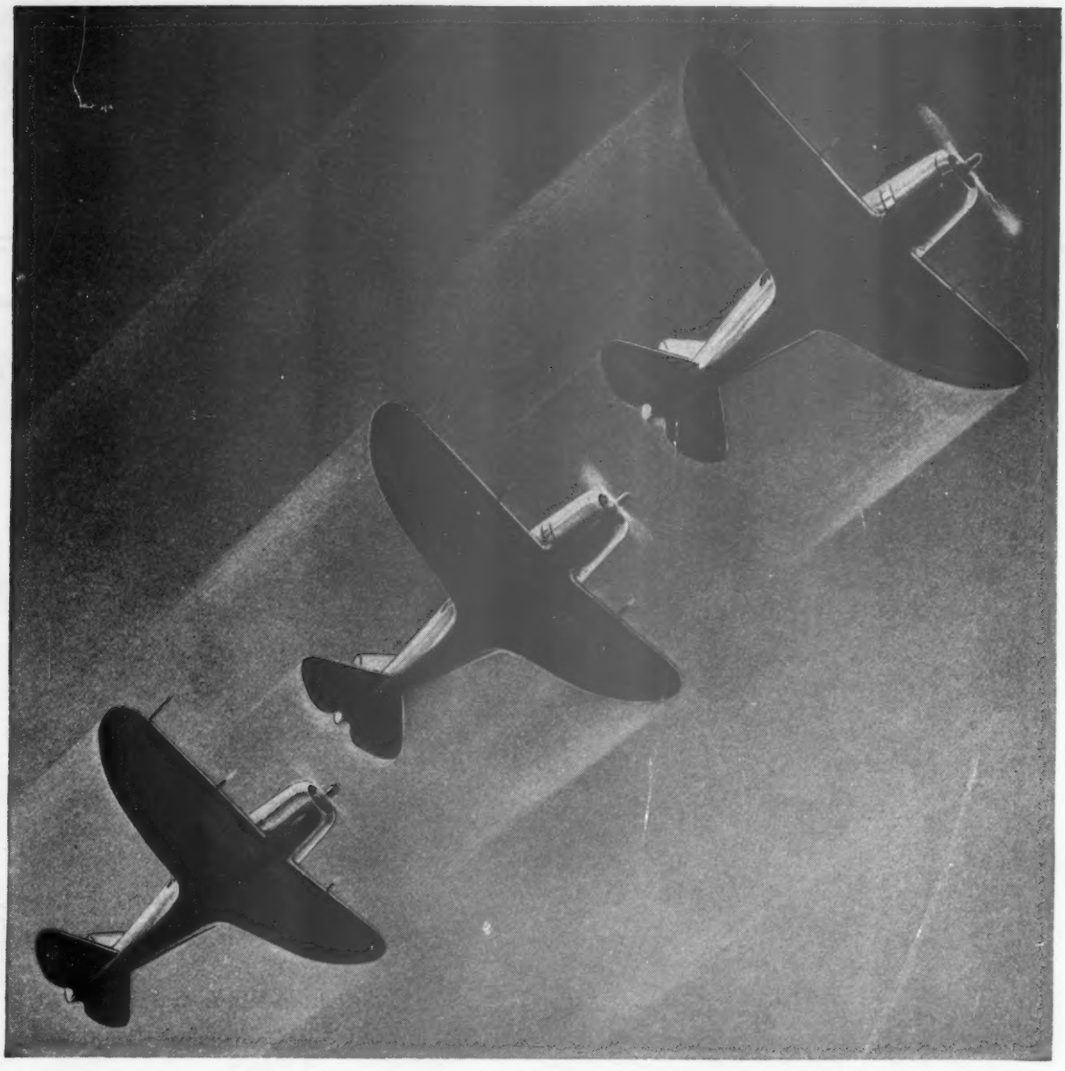
AVIATION IS INDEXED IN READERS GUIDE TO PERIODICAL LITERATURE AND IN INDUSTRIAL ARTS INDEX.



REPUBLIC AVIATION

WITH CONFIDENCE . . . the eyes of the nation look to its air forces, present and developing. Our airplanes and our pilots have no peers. Our rapidly expanding aviation industry—tested, efficient, experienced—will now match high quality with quantity. Together with other units in this great industry, REPUBLIC AVIATION, manufacturers of Pursuit Aircraft, is ready . . . for today's job and tomorrow's.

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Flashes

Picked Up Along Editorial Airways

THE BOTTLENECK ON THE HILL

» THIS BOTTLENECK TALK became so annoying that we did some sleuthing to find the elusive monster that had been tossed back and forth so freely. We made two interesting discoveries. First, the fellows who talk most loudly about bottlenecks are usually the ones who are responsible for them. Secondly, the most serious of all bottlenecks as far as air defense is concerned is reposing comfortably on the Capitol doorstep. For several weeks a completely detailed and well balanced procurement program for strengthening our air forces has been gathering dust in government offices. The Army, Navy, and Defense Commission worked day and night to prepare the program and did an excellent job. It was completed before Congress recessed for the convention. In the closing days of July there was still no legislative action on the discriminatory profit limitation and amortization policies which have harassed the aviation manufacturing industry for many years. Until manufacturers can tell their stockholders that their investment is slightly better than a building and loan association, they are going to have a tough time financing their triple expansion. Up to the end of July only one major manufacturer had secured financing for his expanded plant and only one small order for Army trainers actually had been placed out of 1941 fiscal year appropriations.

» ON TOP OF ALL THIS the British are talking about building additional capacity for 3000 planes a month in addition to those produced for our own needs and Washington is listening sympathetically. Such a program would cost many billions of dollars and would require some 38 factories over and above those to be built in the course of expanding for our own needs. It would mean a total ultimate productive capacity of 76,000 planes per year. The British allotment of 36,000 planes per year would require more floor space and more personnel than our 40,000 rate because

One day about 12 years ago the receptionist in our offices announced the arrival of an inventor to see us. He had his new sensitive altimeter under his arm, and suggested that he demonstrate its sensitivity by riding up and down in the elevator of our office building. We did and were amazed to note that it recorded height changes floor by floor. You may have guessed by now that our visitor was Paul Kollsman. Last month Mr. Kollsman (right) and Mr. F. W. Magin (left) of the Square D Company, which recently acquired the Kollsman Instrument Company, presented $50,000 to the Institute of the Aeronautical Sciences to found an aeronautical circulating library. The donors and Major Lester D. Gardner (center) are to be congratulated on this valuable addition to the Aeronautical Archives, which is rendering an ever increasing service to this rapidly expanding industry.

STEARMAN BUILDS *CONFIDENCE* FOR THE FLYING CADET

SAFETY for the young pilot while he is still learning, before his reactions become automatic, before as well as after he solos—that has always been first in the minds of the men who make up the Stearman organization. We feel that it is not only our duty to offer an airplane correctly designed for instructional purposes, but even more, we consider it a privilege to have cooperated with our Army and Navy in the development of an airplane of such stamina and character that the student can confidently proceed with any training mission. Stearman Trainers are furnished not only for training of U. S. Army and Navy Flying Cadets, but also to the Brazilian Army Air Corps, Cuban Army Air Corps, Argentine Ministry of Marine, Philippine Army Air Corps and Venezuelan Army. Stearman is now producing for the U. S. Army Air Corps and the U. S. Navy the largest peace-time orders for primary trainers ever placed by the United States Government.

BOEING AIRCRAFT COMPANY
SEATTLE, WASHINGTON

BOEING

STEARMAN
AIRCRAFT DIVISION
WICHITA, KANSAS

STEARMAN TRAINERS

the former would be mainly combat ships, while we need a large proportion of trainers at the start.

» IN PRESENTING THE PROGRAM for air supremacy the editors of AVIATION have tapped many sources of information. In order to do the job effectively, a group of members of our home office staff were transferred temporarily to our Washington offices where they worked in close cooperation with our regular staff at the Nation's Capital. At the same time our Los Angeles office was busy gathering material from this important center under the direction of our Pacific Coast Editor.

In this presentation we have attempted to show the present status of our Air Defenses and what is being done to improve them. Naturally some of the details of the long range plan fall into the category of military secrets and must be withheld from publication. In this it is our sincere desire to cooperate with all branches of the military services.

In addition to the contributions of our leaders in defense we have included many contributions from executives in the industry who will execute the plans. The vital problems of plant location and plant financing for contractors are discussed. The section on subcontracting should be of particular interest to industrial firms wishing to cooperate in the defense program and to communities concerned with mobilization of subcontractors from industry in general.

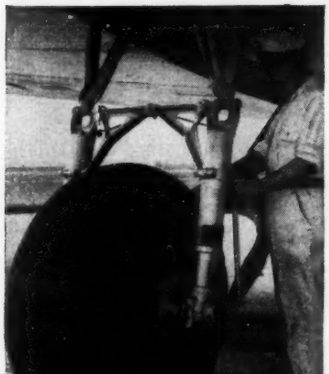
Although this issue is devoted primarily to Air Defense we have not forgotten the commercial side of the industry. A resume of the progress of the Civilian Training Program and its relation to defense is also included.

Without some reference to the important contribution of T. P. Wright in AVIATION for July, this issue is incomplete. Mr. Wright's article "50,000 Airplanes, How Much?, How Long?" constitutes the foundation upon which procurement for the defense program has been based. The author's work with the National Defense Commission has verified the accuracy of this competent analysis. It is required reading for those who wish to be fully informed on the defense program.

Besides the contributors whose bylines appear on certain of the feature articles of this issue we are indebted to many others for their cooperation in the preparation of this issue. Among them are Colonel Eaker, Colonel Candee, Major Ennis, Major House, Captain Hensell, Mr. Rydlun and other members of the Army Air Corps; Comdr. Ring, Mrs. J. B. Hancock, of the Bureau of Aeronautics; Robert Horton of the National Defense Commission and many others.

» PAN AMERICAN AIRWAYS have now completed 200 crossings of the Atlantic. This is a real achievement, considering the Atlantic is the world's toughest ocean—and the 200 crossings have been made without a forced landing. At a time when steamships are undependable, Pan American's Atlantic Division has become the safest and surest trans-Atlantic service. In these 200 crossings the big Clippers have flown some 800,000 plane miles. Revenue passenger miles fall just short of 10,000,000. Over 12,000,000 letters have been carried back and forth. PAA is doing a humanitarian service, as well as operating an efficient airline.

Maguire visits the little men who weren't there.



The Bendix Pneudraulic Shock Strut, Wheel and Brake shown above is of a type in common use on large commercial airline planes. Effective shock absorption, responsive brake-steering and easy stopping are reliably assured.

Cushioning the ground-contact on *"Air Mail Route No. 1"*

VAST have been the improvements in engine performance, aerofoil design and general aircraft refinement in the 20 eventful years of American air mail flight. Yet it is doubtful if any function of the airplane has been advanced more notably than the safety and comfort of landing and take-off.

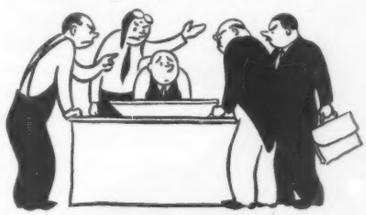
Bendix Pneudraulic Shock Struts and Wheels, standard equipment on such splendid airplanes as the Douglas DC 3's, flown on famous Air Mail Route No. 1, safeguard property, nerves and life. They effectively cushion the initial impact shocks of landing, and absorb the lesser shocks of taxi-ing and take-off runs. To do this, they employ both liquid and air. Their design, in each application, represents a very great deal of highly specialized landing-gear experience. This experience is at the service of the aircraft industry . . . a very tangible advantage of doing business with Bendix.

BENDIX PRODUCTS DIVISION
OF BENDIX AVIATION CORPORATION · SOUTH BEND, INDIANA
AIRPLANE WHEELS · BRAKES · PILOT SEATS · PNEUDRAULIC SHOCK STRUTS

Side Slips

By
ROBERT OSBORN

» BITTER NOTE. Gilbert and Sullivan enthusiasts are all familiar with the song, "An Engineer's Lot Is Not A Happy One," or was that particular song about policemen? As a group engineers are unfortunate in that most of their decisions and answers are in the form of exact figures, often to several decimal places, and when an error is made it is difficult to work up an acceptable alibi. In fact the poor engineer is frequently blamed for the shortcomings of others. Thus the in-



evitable changes made by the Engineering Department kept the Factory Manager from meeting his cost budget; the Assembly Superintendent could have met his schedule if the ships had been designed so that they didn't have to be put together by a group of contortionists assisted by a couple of trained ferrets. The Engine Manufacturer wishes to know how anybody expects an engine to run properly with an installation like that, and the Service Manager could keep the ships flying if so many parts hadn't been made too light and unserviceable. The Salesmen could sell the product if only the Designer had accepted certain valuable Sales Department suggestions, and the President could report more profits to his Board of Directors if only he could find some good engineers somewhere.

The engineer has to acknowledge his mistakes frankly and develop a thick protective hide so that he can "take" whatever comes his way. One of my former professors used to sum up the whole situation in a favorite comment of his. Whenever a student asked him for partial credit for an examination question on which he used the right method but obtained the wrong answer, the professor would simply say: "Damn that decimal point, said the engineer, as the bridge fell in the river."

» NOT SO BITTER NOTE. Looking at the brighter side of the picture, most engineers will admit that many of their decisions are just good healthy guesses or hunches, even though they always put down a few impressive figures on paper to cover up the guess, or stir up a protective smoke screen with a lot of talk about the accuracy and completeness of their

researches. And, some of the most successful engineers will even admit that actual errors have given some of their best results.

When the first oil shock-absorber landing gears were designed in this country, very little was known about them and there was no practical data on which to base the new designs. As one of the large aircraft manufacturers wished to use an oleo landing gear on his new transport, an engineer was assigned to make a thorough study of the fluid dynamics of oil passing through orifices. This man read all of the available literature on the subject, all of which was of a theoretical nature, and after many weeks of work developed some complex formulae involving the viscosity, temperature and density of the oil, the characteristics of the orifice, friction in the telescoping strut, flexibility of the supporting structure and the cushioning effect of the tire. From these formulae he arrived at the proper size orifice for the oil strut, and the landing gear was built.

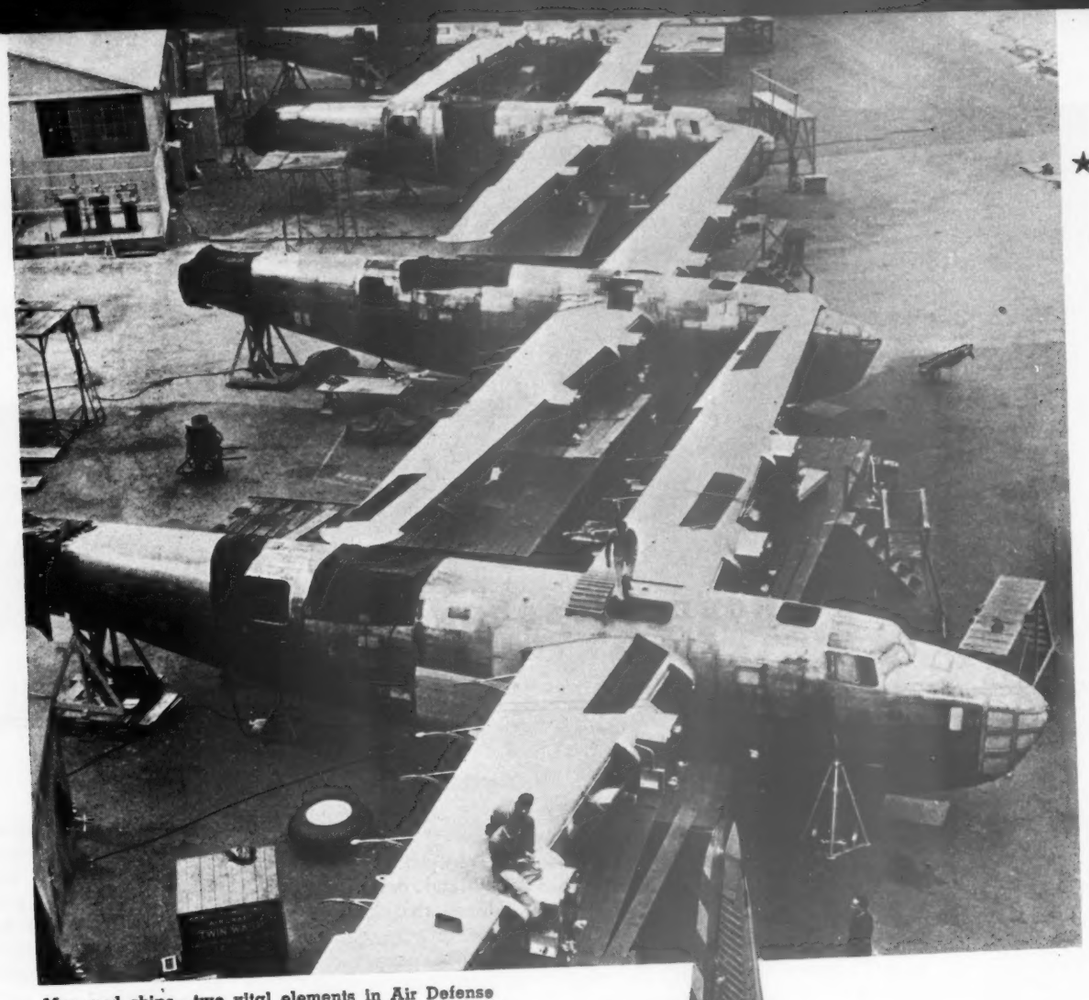
The gear worked beautifully, allowing "feather bed" landings for the transport. Everyone was well pleased with the design and the engineer was congratulated on his good work.

About a year later the engineer was checking over some old drawings and he came over to the desk of the draftsman who had drawn the landing gear oleo strut.

"Say," he said, "What was the idea of making this orifice so small?"

The draftsman thumbed through his notebook and said, "That orifice is right. You told me to use a quarter inch radius."

"No. I told you to use a quarter inch area, which would have been thirty percent larger than this hole."



Men and ships—two vital elements in Air Defense

BILLIONS
FOR AIR DEFENSE

The military aircraft manufacturers are in for a three-fold expansion in plant space and five-fold increase in personnel.

By Leslie E. Neville
Managing Editor, Aviation

NOT so long ago the people of these United States read in their newspapers about a war in Europe. They were excited for a few days and then some local murder mystery or some football scores displaced the war news in the headlines and everyone went about his business and forgot the belligerent Old World. A cold winter came on and nothing much happened but the occupation of some little countries that most people couldn't find on an outline map.

Maytime brought new headlines about the invasion of countries nearer home but the invaders worked so fast that the headlines didn't keep people excited long enough to do much about it. And in a democracy you have to keep the people excited or they don't do anything about anything. But some of the boys whose job it is to defend these shores stayed excited and the President asked the Congress for a lot of airplanes. The War Department people had asked for them before but had been called warmongers and hadn't got to first base. This time, however, the people stayed excited long enough to tell their Congressmen to say yes and they agreed to appropriate a first payment on a program for defense. All this was done in spite of recesses for Presidential Conventions, a hot summer in Washington, and a long week end to celebrate our independence.

A program for the defense of this nation is no simple matter. With allies changed to potential enemies in a fortnight, with age-old empires tottering, with the spell of the Yukon above us and a strategic strip of poorly protected water below us, with a couple of shrinking oceans around us and with Lord only knows what in South America, our defense experts were stumped about what to defend against whom. And you can't exactly blame them. So the overall defense policies were not forthcoming.

Out of this abysmal chaos one simple fact stood out clearly. Even if we didn't know what to defend against whom, we knew we needed a lot of airplanes as a start. And through no fault of our own as a nation, there was an industry all ready to build them. True we had starved out that industry with discriminatory profit limitation and scant orders but these aircraft makers were strange people. They hadn't let us get them down. Because while they were starving they couldn't afford worldly pleasures and they spent their nights and Sundays making their products so good that almost every nation in the world besides ourselves had bought them. So their plants stayed open and they were ready when their own country decided it needed airplanes four or five years too late.

We have said that the aviation industry is better prepared to begin its job than most of the other defense industries. We hear of shipbuilding plans that will require years to yield the battleships necessary for a two-ocean navy. We hear of artillery programs that will require 18-24 months to get started. We know that aircraft are being built in reasonable quantities and can be built in larger quantities almost immediately. But, far more important than actual numbers of airplanes, is the expansion of capacity to produce them.

In the last few weeks the accelerated activity of the British Purchasing Commission and several increments of Army and Navy procurement have resulted in more nearly complete utilization of the present capacity of the industry. In the period from May to July of this year, the production rate increased from 6,000 to 8,250 planes per year and rapidly approached the present potential capacity of 10,200 per year.

While the production rate was moving toward full capacity, the Army, Navy, and Aviation Advisory Council of the National Defense Commission were hard at work developing a program to increase the capacity of the

industry several fold. Full details of the completed expansion program have not been revealed but the overall dimensions of the project require approximately a three-fold expansion of the present floor space and a productive capacity of about 40,000 airplanes and 100,000 engines per year in a two-year period. In this course of the expansion period an accumulated production of 40,000 airplanes for our own air forces and for export delivery is expected. As this is being written there is some difference of opinion as to the length of the expansion period. The completion dates under discussion are April 1 and July 1, 1942. Although the three-months difference may seem inconsequential at first sight, it is hoped that the earlier date will be selected. The earlier objective will bolster the capacity at a much higher rate and will provide very much higher capacity values at intermediate points in the expansion period.

These estimates compare closely with the basic analysis published last month in AVIATION ("50,000 Planes a Year. How Much? How Long?" by T. P. Wright). The author's first recommended objective in a 50,000 plane program was a combined air force of 25,000 planes plus 50 percent more for the Allies and provision for a 20 percent replacement for our air forces, in 2½ years. The essential difference in the new program is that it demands a substantial speed-up. Whether or not the new deadlines under consideration will be attained remains to be seen but the urgency of the situation justifies the attempt at greater speed. Although the defense program may be ambitious it is not impractical. It is based on the known performance of the existing industry and streamlined for increased speed.

It is unfortunate for all concerned that the fantastic figures of 1,000 and 5,000 planes per day became impressed on the public mind. These boasts have led laymen to believe that aircraft production is as simple as automobile manufacturing when, actually, it is a much more exacting and different problem, when the rigid specifications of our military services must be met. There is plenty of production talent in the aviation industry but there have never been sufficiently large orders to justify its full use.

Even in the present program, which calls for an air force of unprecedented size, there are so many different types required that there is no demand for production rates of even 100 aircraft per day of a single type. Probably no allotment in the present program exceeds 3,500 planes of one type and that is a generous estimate because about 40 types are involved in the program. This number of ships could be built comfortably in two years at the rate of seven per day.

It would be comforting to have these airplanes sooner but who would fly them? The training program has been stepped up almost three fold but even that is inadequate to provide pilot power for the present procurement program. (For details see page 40.) If the airplane building program is fully realized, some of the ships may have to be kept in storage until we build men to fly and service them. This is not at all surprising. It has been the experience of other countries including Germany.

The automobile companies have tossed the Rolls Royce Merlin blueprints around so much that it is hard to keep our eye on them. They seem to have fallen finally into the Packard lap. The Packard program of eighteen months to reach full production seems properly conservative and probably attainable. Experience has shown that it takes nearly a year and often more to get the first production engines out of a new plant. The slow start at Allison is in no sense derogatory to Allison or to General Motors. Actually it is a measure of the true magnitude of the problem even when approached by an organization of substantial experience and resources. Airplane engine building has never been a cinch. As engines grow bigger and give more horsepower per pound, it isn't going to be much easier. Our sympathies are with those who try it for the first time.

This doesn't mean that there is no place in the program for the automotive manufacturers. If any of their facilities can be spared after they have received their production allotments of tanks, trucks, and other vehicles which are needed in larger quantities than aircraft in a well balanced mechanized unit, they can be used very effectively as subcontractors to the aircraft industry. Already this is being done to some extent. The subcontractors picture in the program is not unattractive. At present about 10 percent of the billion dollar backlog is distributed among relatively few subcontractors. If we assume an approximate expansion ratio of three, the subcontracting business should be good for about $300,000,000 for the next two years and an equivalent amount annually for the duration of the program. These stakes should be high enough to attract many responsible organizations. Some suggestions to possible subcontractors and to communities seeking potential aviation subcontractors in their general industry will be found on pages 48, 49 and 50.

From the basic study presented in Mr. Wright's article last month and his earlier studies of productive capacity (April, 1940 and June, 1939) we may estimate that a 40,000 plane program will require a five-fold increase in direct labor, amounting to a total of about 380,000 persons as compared with the 76,000 at present employed. In many respects this represents a more serious problem than the space expansion. It will require multiplication of the present facilities of our mechanics schools, widespread introduction of apprentice training programs, and utilization and expansion of many vocational high schools. It will also require the cooperation of organized labor and labor organizations. Availability of skilled and semi-skilled labor in quantities will become a major factor in selection of new plant locations.

The physical expansion of the industry will cost about $350,000,000, and present plans are based on expansion of existing companies according to the aircraft types they now produce. Allotments of types and numbers to various companies have been made and from these allotments, the expansion ratios for each plant, ranging up to ten, have been calculated. As the orders are placed, companies will be requested to comply with these predetermined expansion ratios and will be given considerable latitude as to the method they wish to employ. For strategic reasons it is considered desirable to set up new plants in new localities separated in some cases by considerable distances from their parent organizations but this is not the first consideration in plant location. (Details of the plant location problem will be found on page 55.) Some new plants will probably be operated as subsidiaries of the parent companies for financial reasons. Three ways have been devised for manufacturers to borrow government money for plant financing. (For details see page 46.) The fourth and most desirable to many plane and engine makers will be private financing.

But private capital can't be expected to rush into airplane manufacturing expansion while the industry is hamstrung by discriminatory profit-limiting legislation. One of the most serious bottlenecks in aircraft industry expansion has been the efforts of our legislators to include it in the category of battleship building

(Turn to page 142)

The Challenge of the Times

"The principal lesson of the war up to the present time is that partial defense is inadequate defense. If the United States is to have any defense, it must have total defense. We cannot defend ourselves a little here and a little there. We must be able to defend ourselves wholly and at any time."

The President of the United States

Aviation's Part in National Defense

THE outstanding lesson of the European War is the tremendous importance of aviation. In the expansion of our armed forces it is essential that we profit by this lesson. Naval Aviation as an integral part of the United States Navy has achieved an enviable reputation throughout the world. In the current National Defense Program the present organization will serve as a nucleus for the rapid expansion which Naval Aviation must undergo.

Many additional pilots must be trained and aircraft must be provided for their training. Our fighting, bombing, scouting and patrol squadrons must be increased many fold and the very best aircraft obtainable must be furnished in these various types.

The problems we face are many, but they are being attacked vigorously. The Army and Navy are working hand in hand and with the close cooperation of the National Defense Commission and the aeronautical industry, the aircraft requirements can be met.

Col. Frank Knox,

The Secretary of the Navy

Col. Frank Knox.

Dr. George J. Mead

CONGRESS has been asked for adequate funds to carry out the present program, which will provide 25,000 airplanes by July 1, 1942. It is evident that a program of this size requires plant capacities far in excess of normal. A plan has been worked out whereby industry can secure Reconstruction Finance Corporation loans to finance additional facilities. I believe the industry will be perfectly satisfied with the method proposed for amortizing the expansion.

Aircraft requirements are defined by the Army and Navy. The National Defense Advisory Commission is simply an agency to assist the Army and Navy in satisfying them. It does not take their place. Close cooperation by the military services, the industry, and the Commission has produced a balanced aircraft program, coordinated with the defense program.

The Army and Navy are in complete accord. A system has been perfected whereby if one service had more business dealings in particular fields than the other, all contacts in that field are handled by that one service. This service will then turn over to the other the equipment required. The Air Corps and the Bureau of Aeronautics have agreed on a common engine test, thus facilitating production materially. In the matter of price on contracts to be placed jointly, we want to take into consideration total quantities, but we will not change contracts already placed.

We want the best equipment approved at the moment, but we are not closing our eyes to development. Research and experimentation will be carried on simultaneously with production.

Dr. George J. Mead,

Director of the Aeronautical Section for Production Division, National Defense Advisory Commission

THE ARMY AIR CORPS

AIRPLANES NOW ON HAND
(approximate figures)

TRAINERS	800
PURSUITS	525
LIGHT BOMBERS	200
MEDIUM BOMBERS	315
HEAVY BOMBERS	60
MSCL. (TRANSPORTS, OBSERVATION, PHOTO, ETC.)	1,100

TOTAL 3,000

PERSONNEL
PILOTS

REGULAR ARMY	2,100
RESERVE CORPS	1,000
IN TRAINING	1,524
PLAN TO HAVE BY JULY 1, 1941	6,300
RESERVE (NOT ON ACTIVE DUTY)	3,300

ENLISTED MEN IN THE AIR CORPS

NOW IN SERVICE	43,238	IN TRAINING	12,769

MARINE

PILOT PERSONNEL

REGULAR MARINE CORPS OFFICERS	187	MARINE CORPS ENLISTED MEN	46
RESERVE MARINE CORPS OFFICERS	102		

TOTAL 335

THE NAVY

BUREAU OF AERONAUTICS

AIRPLANES NOW ON HAND
(approximate figures)

TRAINERS	288	
SCOUT OBSERVATION	302	
FIGHTERS	192	
SCOUT BOMBERS	519	
TORPEDO BOMBERS	114	
PATROL BOMBERS	240	
MSCL. (UTILITY, TRANSPORT, ETC.)	158	

TOTAL 1,813

PERSONNEL

PILOTS

REGULAR NAVAL OFFICERS	1,093	
RESERVE NAVAL OFFICERS	930	
ENLISTED MEN	597	

TOTAL PILOTS 2,620

NON-PILOT PERSONNEL

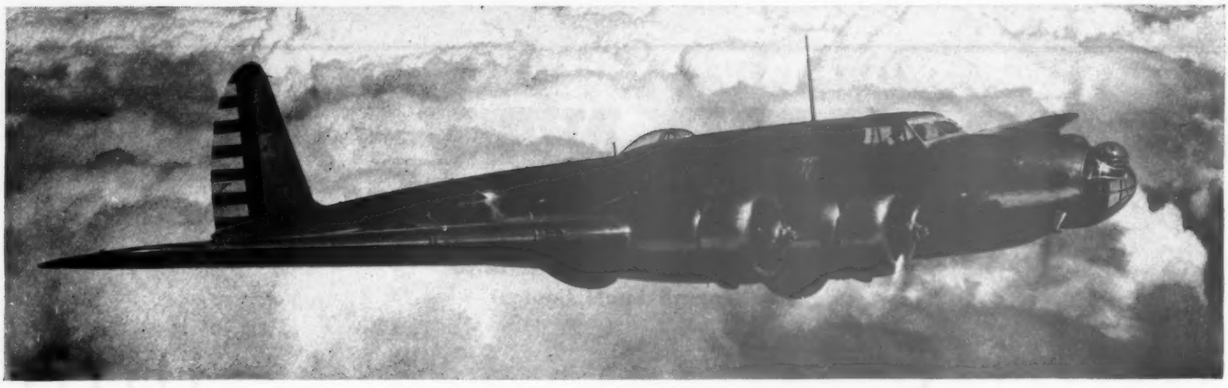
OFFICERS	591	ENLISTED MEN (B. OF A.)	17,101

CORPS

NON-PILOT PERSONNEL

MARINE CORPS OFFICERS	15	MARINE CORPS ENLISTED MEN	856

TOTAL 871



The Air Corps' greatest long-range striking weapon, the Flying Fortress

THE NEW ARMY AIR FORCE

By Major General H. H. Arnold

Chief of Air Corps, U.S.A.

The defense plans are working themselves into shape more and more each day. As we go to press, Congress is holding hearings on additional appropriations for our Army Air Corps—some $1,500,000,000 that will give it a total of 25,000 planes and nearly 140,000 mechanics and flyers.

I CAN remember when the Army had but one airplane, the world's only military airplane. I can recall when it had but one squadron—nine mousetrap airplanes represented our whole air force.

I saw that squadron grow to one hundred fifty thousand men, thirty thousand pilots and twenty thousand planes in 18 months as we tardily speeded up during World War I.

So, I was not appalled when we were asked last year to expand to an Air Corps of five thousand five hundred planes, forty-five thousand men and four thousand five hundred flyers. Likewise, more recently I have neither been dumfounded nor dismayed when, as the iron hail began to fall from the war clouds on the other side, we were given funds for an additional increase before the first expansion was finished. I am not pessimistic now about the ability of the Army and the civil aeronautic industry to meet this new expansion for which the present 76th Congress has given us over seven hundred fifty million dollars to build an Air Corps of about ninety-five thousand mechanics, twelve thousand pilots and ten thousand planes.

General Arnold

There have been critics who say that we cannot efficiently expand the Army Air Corps from its size of a year ago—20,000 men, 2,000 pilots, 2,000 planes — to the proportions I have just outlined above within a period of two or three years. There is criticism even today of the methods we are pursuing to give this nation an adequate air defense. I am convinced that these critics are public-spirited and patriotic citizens, who are not antagonistic to their country's interests, but that they are merely misinformed or uninformed. I think it is in rare cases only that their criticism is malicious or destructive. These misguided patriots are deeply concerned about the future welfare of their country. For this reason I propose to outline briefly our purpose, plan and objective in producing this new enlarged American Air Force.

Remember what we had when we started, the foundation we are building on: about 20,000 men; less than 2,000 Air Corps Officers; a little more than 2,000 airplanes, less than 500 of which were of modern combat types; and 60 squadrons.

Here is what we must accomplish with the funds appropriated thus far; enlist, train, and organize an Air Corps of about 95,000 men; train 10,000 flyers; build more than 10,000 new airplanes; and organize, equip, and train about 75 new squadrons.

Between those differentials lies our task. The principal factors which we have to employ, are money, time, and labor. The total money appropriated to date with which to accomplish these expansions is more than a billion dollars. We have two years in which to accomplish the task. It must be completed before June 30, 1942.

By way of labor, we have 20,000 old and experienced men and 2,000 trained officers aided and abetted by the civil aeronautic industry, employing more than 100,000 skilled workers and superior craftsmen.

There you have it. It is no simple task.

Germany began more than seven years ago to build a great air force, which was designed and fashioned to conquer Europe. Only during the past summer did that air army reach its present vast size, and demoniac efficiency. England began in 1933 to

build up her air force. In 1938, she redoubled her effort. Only recently has she been able to accomplish the results she desired, and she was aided tremendously by foreign aircraft industries. Air forces are not built in a day.

Of the three factors I outline above; money, time and labor, perhaps the most important and indispensable is time. There is no substitute for time. It cannot be bought nor improvised. A keen Army officer recently made a sad but astute observation, "In years gone by we had all the time in the world but no money. Now we have all the money in the world but no time." He was talking about the good old American habit of waiting until the house is on fire before we take out insurance. Money can buy labor and materials, but that indispensable third variable, which God chooses to measure second by second, is supplied alone by natural laws.

We know now that we can enlist and train enough air mechanics to reach an air corps of 95,000 within a year. We know this because last year without difficulty, we enlisted and trained nearly 30,000, and we were just starting then.

We know that we can train 7,000 flyers within a year—thanks to the able cooperation of the nine civil flying schools which are giving our primary training. We shall reach that 7,000 pilots per annum capacity within twelve months by enlarging those civil schools about three times and by creating two additional training centers, similar to the flying schools now operating at full capacity at Kelly, Brooks and Randolph Fields, San Antonio, Texas.

We know that the aeronautic industry in this country can build 10,000 planes within the next two years for our Army Air Corps, in addition to those we may sell abroad and build for our Navy. We know this because we have made the most accurate survey of the present capacity of our aircraft industry and because we are well acquainted with its leaders, executives, directors, engineers, and skilled labor.

I take little stock in this business that the American aircraft industry cannot supply our needs. I can remember the last World War. In the beginning the American aircraft industry had a capacity of less than 100 planes a year. I saw one factory sign a contract eighteen months later to deliver 100 planes a day! Within that period of eighteen months, the American aircraft industry turned out more than 30,000 engines and 20,000 planes. The American aircraft industry today is incomparably superior in every regard to the state it had reached even at the close of the last World War. It has millions more square feet of floor space. It has many times the tools and labor-saving machines. It has more engineers and designers, and it has nearly ten times as many skilled laborers.

So, make no mistake about it, we shall train the mechanics; we shall train the flyers; and we shall build the planes. We shall have, then, but two other tasks to accomplish. We shall have to take these mechanics, pilots and planes, organize them into flying squadrons and teach them to fight, to shoot, to bomb, to overcome any enemy in the air. It takes from six months to a year after the planes, pilots, and mechanics are poured into the hopper (the flying field), before the units are formed and equipped, and the personnel is adequately trained, so that we can point to it and proudly say, "There is an air force!"

That remaining task is this: We must organize these squadrons into groups, wings, air divisions, and finally into a General Headquarters Air Force. We must train the air force to fight with the Army and carry out independent air force missions. We must school and instruct a body of able officers in command and staff functions, capable of leading intelligently in any air battles that may confront us this air force which we have created.

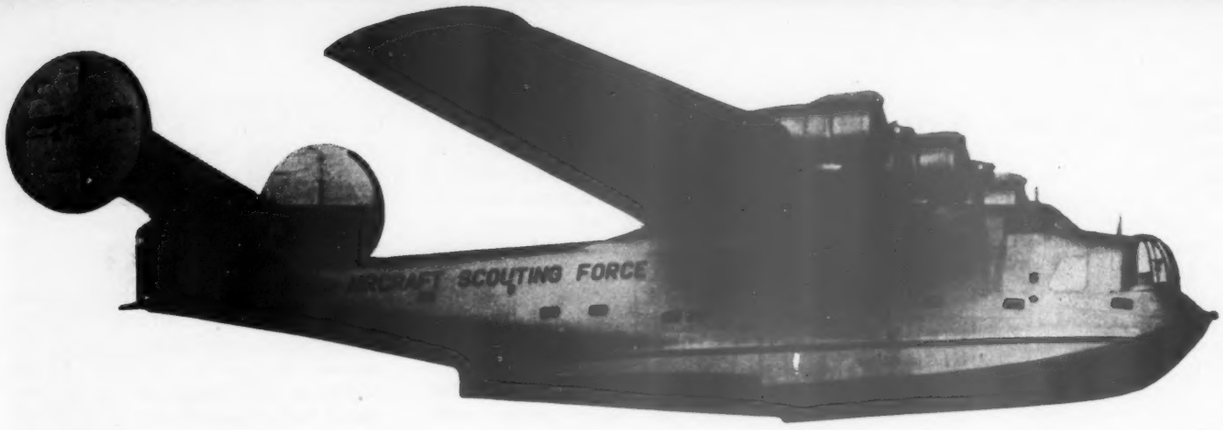
There lies the task. When it is accomplished, less than two years hence, we shall have the New American Air Force. We can do it. We could do more under pressure of grim necessity.

It will not be the largest air force in the world, it may not be enough, but it is a giant stride in the right direction.

Official photographs, U. S. Army Air Corps

Douglas DB-7, a powerful light bomber developed by Army engineers cooperating with engineers from the Douglas plant. France ordered many of this type.

First need of an air force is trainers. This is the Fairchild PT-19, a low-wing, two-place primary trainer, powered with a 175 hp. Ranger. Most interesting feature of this ship is molded plastic wing.



The NAVY EXPANDS Its

By Rear Admiral John H. Towers, USN

Chief of the Bureau of Aeronautics

NAVAL AVIATION has taken on new meaning and significance in the past few months. With one European nation after another crumbling before our eyes, it has become increasingly important that the vital air arm of the fleet be enlarged. In keeping with the general building program that is now going on through the Navy, the Bureau of Aeronautics has been given stewardship of funds for a large increase in naval aviation.

The possibility of this enlargement is especially gratifying to those of us who have been staunch believers in Naval aviation for many years. Additional funds recently voted by the Congress will provide the means for additional airplanes as well as for bases.

For a number of years the Bureau of Aeronautics has laid a careful plan of experimentation and testing. Airplanes of various types, from small trainers to the great patrol bombers, have been put through the grilling tests of active service. As a result of these years of careful purchasing when our appropriations were relatively small, we have established a sound basis for placing the large orders which the new funds now provide.

A modern fleet is a highly complex organization, and in its service to the fleet, the air arm must provide a variety of services. To meet these services requires a balanced air force consisting of several types of planes. Numbers alone are not our aim, balance, too, is essential. With our new appropriations we will have both.

Rear Admiral Towers

Expansion Plans

From a present force of approximately 1,800 modern, useful airplanes, the Navy is expanding as rapidly as possible to an authorized strength of 10,000 airplanes. When it is realized it has taken us a number of years to build up our present naval air force, the great expansion to over five times that number becomes especially significant. With its new planes, our Navy will have an air arm that for either quality or quantity will not be equalled by any foreign power.

The Bureau of Aeronautics now is using a variety of types of airplane, each developed for a particular purpose. Both land and seaplanes are used for training, and are assigned to the Naval Air Station at Pensacola or to the Naval Reserve Aviation Bases throughout the country. Advanced training is done in all of our airplanes.

Combat planes are based with the Fleet, either as mobile units (as are patrol squadrons) or as ship-borne units on the carriers, battleships and cruisers. Each of the 15 battleships in service has three planes, the 37 cruisers each have four planes, and each of the six carriers has 75 planes. Carriers normally carry four squadrons of airplanes. The types of squadrons vary somewhat among the different carriers but consist in general of fighters, scouts, bombers and torpedo planes. The long-range patrol bombers, although Fleet units, are assigned home ports at the various air stations located at strategic positions along our coasts or in our Pacific island possessions.

Orders for new planes in each catagory have been placed. In fact, airplanes are now being received each month that were ordered during the past fiscal year. Types that will be used on shipboard are being coordinated for delivery at the time they will be needed to take care of the new ships under construction. Approximately 1,000 airplanes were ordered during the fiscal year ending June 30, 1940, and it is from those ordered under 1940 appropriations that we are now receiving our airplanes.

In a period of rapid expansion, the first need in the way of airplanes is for trainers. In the past, a large share of Navy trainers have come from the Naval Aircraft Factory in Philadelphia. Present demands for trainers far exceed the output of our own factory in Philadelphia, and we are turning to several aircraft manufacturers to supply training ships. Orders

Upper left: giant Consolidated patrol bomber. Upper right: Grumman fighter. Lower right: Students being instructed in handling small seaplanes at Pensacola (Harris & Ewing). Official photographs U. S. Navy.

Aircraft and Base Facilities

for trainers have already gone out to Stearman, Spartan and the Naval Aircraft Factory. Other trainers will be ordered.

New Carriers

Six carriers are now in service: the Saratoga, Lexington, Ranger, Yorktown, Enterprise and Wasp. The Hornet has been under construction for some months. Contracts have been let for four additional carriers, bringing the total of built and building to eleven.

Orders have already gone out for one large seaplane tender and two smaller tenders which will provide valuable additional equipment.

Pilot Training Program

The combined number of pilots on active duty with both the Navy and the Marine Corps totals about 3,000. It is planned to increase this number to approximately 16,000 as soon as additional training facilities can be established.

To provide for this great expansion, training facilities are being enlarged at Pensacola, and new training facilities are being added at both Jacksonville and Miami. The latter base will be for certain phases of advanced training.

An entirely new training station, duplicating the splendid facilities at Pensacola, will be constructed at Corpus Christi, Texas. Some $25,000,000 has been approved for this station, and we anticipate that it will contribute an important part in naval aviation training in the future. It is expected that this station will be ready for its first students next year.

Elimination training will continue to be given at the thirteen Naval Reserve Aviation Bases as in the past. The number of instructors, airplanes and the amount of equipment at all these bases is being enlarged or increased in order to take care of the greatly augmented number of students. A number of new Reserve bases are being planned.

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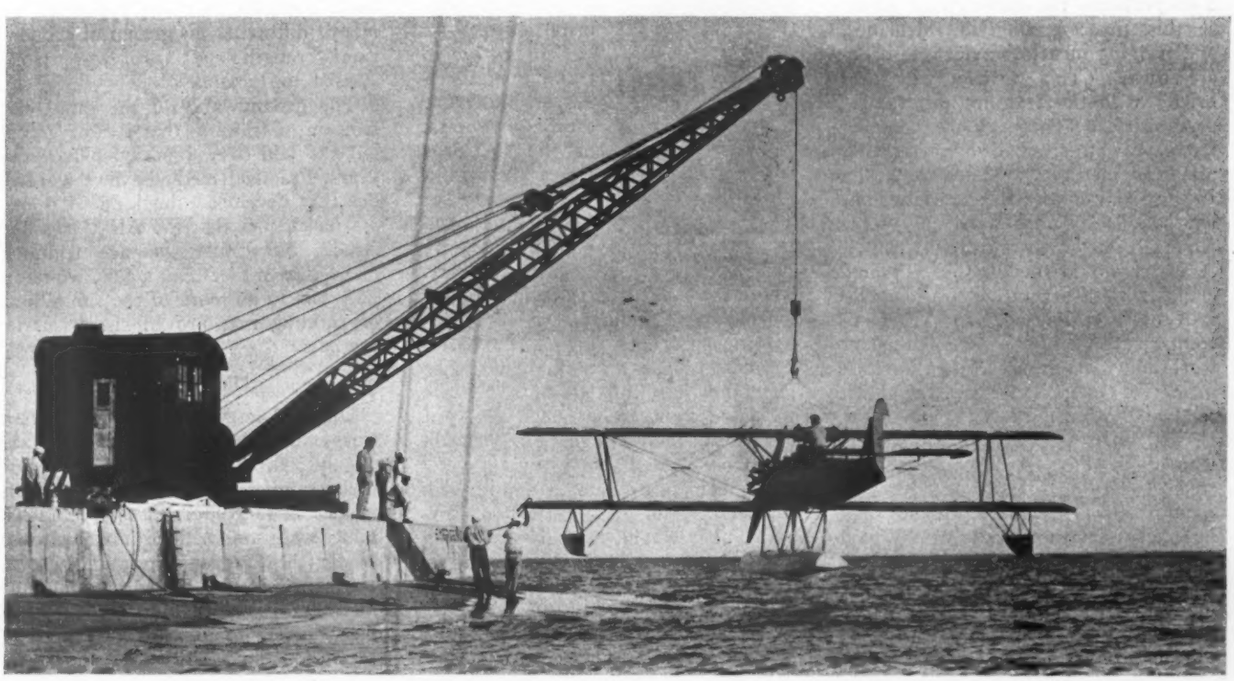

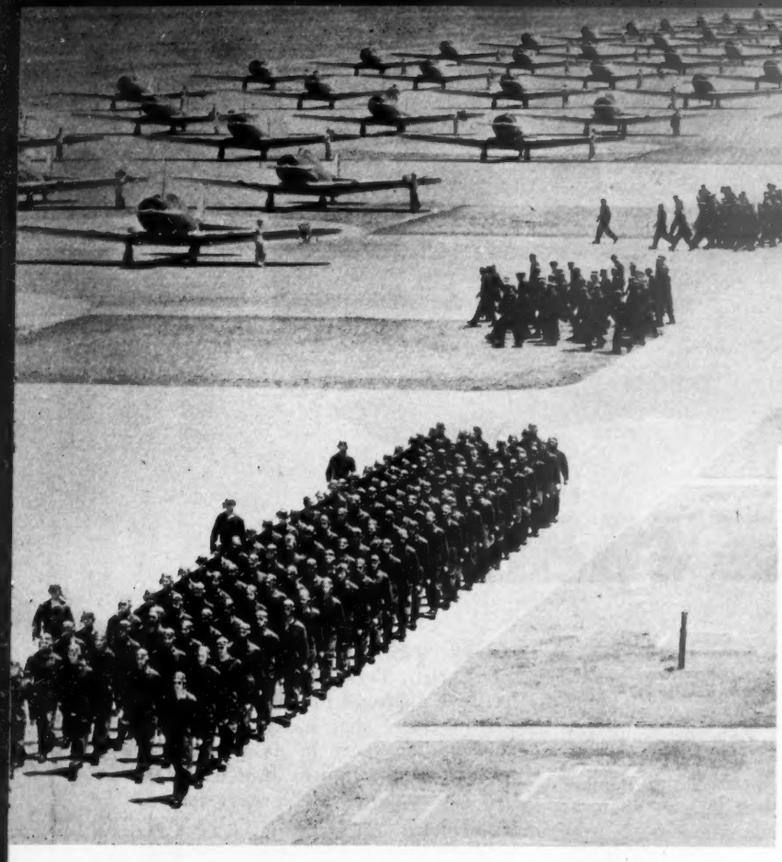

Cadets undergoing basic training at Randolph Field, Texas.

ARMY SPEEDS UP TRAINING IN THE AIR CORPS

How the Air Corps will train its new pilots and mechanics

By Brig. General Jacob Fickel

Chief of Training and Operations, U. S. Army Air Corps

IN its great expansion program, the Air Corps has many problems. Two problems far outweigh all others at this time: getting the airplanes, and training men to service and operate them. This article will deal briefly with the training program.

As airplanes grow more complex from year to year, proper training plays an increasingly important role. In the last war airplanes used in combat had speeds that were only some 50 m.p.h. faster than training planes. A man who learned to fly a Jennie could, with little further training, do fairly well on fighting planes. Instrument panels, and other equipment were much the same. But today the primary trainer is a long way down the ladder from the fast pursuit or the Flying Fortress. The pilot must be trained in the several intermediate steps.

So it is also with mechanics and maintenance men. In the first World War almost any soldier who was handy with tools could make repairs on the fuselage or landing gear of an airplane. A mechanic today must be a real specialist before the Army permits him within arm's reach of its expensive, all-metal ships.

General Fickel

Not only is training today a longer, and more thorough process, but the Air Corps trains men in a wide variety of jobs. Pilots and mechanics only begin the list. There are bombardiers, navigators, radio operators, gunners, engineers, armorers, parachute riggers, and other specialists. The term mechanic is so general it has little meaning, because we have a dozen or more kinds of mechanics, each a skilled craftsman in a narrow field of work.

To complicate our training still further, we have a variety of airplanes that would drive most training divisions of a large industry frantic. The commercial airlines are able to standardize on one, or at most two, types of airplanes. We have a dozen or more—yet our standards of perfection must always be maintained. Still another difficulty is that we must teach methods that are applicable to many different geographical conditions, ranging all the way from Alaska to Panama.

The groundwork for the rapid expansion in training that is now going on was laid over a period of several years. Practical methods were worked out that developed the kind of pilots and mechanics that the Air Corps desired. Now that we are training many men rather than a few, we have only had to do more of the same kind of training that proved successful in the past.

Pilot Training

Until about a year ago the Air Corps had been training approximately 500 pilots per year. All began their training at Randolph Field, then moved on to Kelly and the successful pilots were assigned to the squadrons. Under the 1940 appropriations, funds were provided for the training of many additional pilots. To step up the numbers of pilots from some 500 to 2,288, the facilities of nine pri-

vately-owned flying schools were utilized, beginning on July 1, 1939. The nine schools enrolled enough students every six weeks so that 238 were graduated for entrance to Basic Training at Randolph Field at the end of each training period. Previous figures indicated that about 215 students would graduate from Randolph to the advanced training at Kelly Field, and that about 208 would complete this third step of the training and be passed on to the Squadrons, thus giving the Air Corps approximately 2,288 pilots.

nine new schools will be branches of the nine original institutions. Thus each school now being used will divide its teaching staff, and half the instructors at each of the eighteen schools will have experience in our methods. The Alabama Institute of Aeronautics at Tuscaloosa will establish a new school at Jackson, Miss. Allan Hancock College of Aeronautics at Santa Maria, Calif. will continue its instruction. Chicago School of Aeronautics will build a school at Albany, Ga. Dallas Aviation School will start a branch at Ft. Worth. Cal-Aero Training Corp. of Glendale will establish schools at Oxnard and Ontario, Calif. Lincoln Airplane & Flying School will start its branch at Lakeland, Fla. Parks Air College will build a school at Sikeston, Mo. Ryan School will build a branch at Hemet, Calif. Spartan School will build at Muskogee, Okla.

To handle the pilots from these eighteen schools, the Air Corps is building two new training centers. The Southeast Training Center is at Maxwell Field, Montgomery, Ala. The West Coast Training Center is at Moffett Field, Calif. The Gulf Training Center will remain at Randolph Field, Tex. Thus pilots from the commercial schools will feed into these three Centers for basic training.

Each training center will have several fields, just as the Gulf Training Center has Randolph, Kelly and Brooks at present and will soon have a new field at San Angelo, Tex.

Pilots will receive ten weeks primary training at the civilian schools, ten weeks basic training at a Training Center, then ten weeks advanced training at another field of the same Training Center. After graduation from the advanced flying school, pilots will go to a specialized school for five weeks of training on equipment like that he will fly in combat. Even then his training will not be completed. School is never out in the Air Corps, and the pilot's training will be continued in the tactical unit to which he is assigned.

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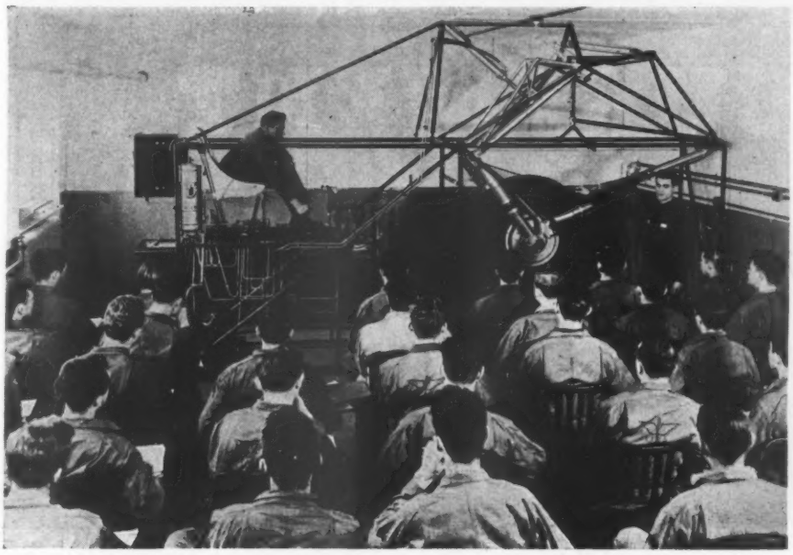

Above. Mechanics at Chanute Field, Illinois, studying the hydraulic system of a B-18.

Begun with some doubts, the use of the nine commercial schools has proved eminently successful. Classes were smaller than they had formerly been for primary training at Randolph. Instructors, all of whom had gone through a refresher course at the Army Training Center, were able to give a great deal of individual attention to beginning pilots. The commercial schools were anxious to make a good record and instructors worked hard to give thorough teaching. The results, with a few exceptions, have been most gratifying.

With this method in operation for a full year, the Air Corps is again stepping up its pilot training program. In place of the 2,288 pilots, we now have funds for training 7,000 pilots per year. We propose to carry out this greatly expanded program in the following way.

In place of the nine schools, we will use eighteen commercial schools. The

Below. Many pilots, bombardiers and gunners will be trained for the new bombers now being delivered. *All photos, U. S. Army Air Corps.*

PROCUREMENT FOR DEFENSE

After the Air Defense expansion program has been decided it is the job of the Materiel Division to procure the most efficient planes and equipment. Here's how the industry looks to them.

By Brig. Gen. George Brett
Assistant Chief of Air Corps

OVER a period of years the Air Corps has developed its procurement system so that today the purchase of a standard type of airplane, engine, propeller and other Government-furnished-equipment, including special accessories, is generally confined to three or four potential bidders. Due to this situation, it was logical that Congress should modify its restrictions on Air Corps purchases. A long sought for change is permitted in the recent legislation which reads in part: "in order to expedite the building up of the national defense, the Secretary of War is authorized . . . with or without advertising . . . (2) to provide for the development, purchase, manufacture, shipment, maintenance and storage of military equipment, munitions and supplies." It is expected that Supplemental Rearmament Legislation proposed by the President in a recent message will add considerably to the Air Corps program as now authorized.

The Air Corps is hopeful that the delays incident in the old system of procurement will now be eliminated and that negotiation will permit of a continuation of the procurement of the various types of airplanes without interruption. It is recognized that approximately seven to nine months elapse before the airplanes developed from an experimental type previously supplied can be rolled out of the door and flown away. This is due to the design, development and production of jigs and fixtures, and miscellaneous tooling and the delay in deliveries of raw and semi-finished materials. Other factors contributing to this delay are miscellaneous services and the supply of parts from subcontractors.

The specifications necessary for the present procurement program are in general available without major changes. Detailed specifications relating to the raw materials have been

developed in the light of changing processes and improved raw materials. This is a product of the dynamic characteristics of the aircraft industry. It is in a constant state of flux. Whereas an experimental airplane may precede a production airplane by from one to four years, the details and refinement of the service article parallel the tests being conducted on the experimental airplane. Hence, today's program is benefiting from the experimental airplane developed in 1936 through 1939.

The Contribution Of Industry

In the year that has elapsed since enactment of the 1940 F.Y. appropriations, the aeronautical industry has multiplied its manufacturing facilities in all its aspects. From an estimated 35,000 personnel, the aircraft industry has increased its direct labor to approximately 100,000. Seventy percent are employed in the airframe industry, 18 percent in the engine industry, and 12 percent divided between the propeller, instrument and other accessory manufacturers. Paralleling this increase in personnel, plants have approximately tripled their floor space and the necessary manufacturing facilities. It is difficult to estimate the proportion of personnel employed in such basic industries as the steel, aluminum and other nonferrous metal producing industries, but doubtless a considerable number of such personnel contribute toward the aircraft industry. These increases in floor space, personnel and manufacturing facilities have been carried out in spite of the trend toward standardization of types of aircraft. In order to achieve this production and contribute toward standardization, the engineering personnel has increased approximately in the same proportion.

Since the aircraft industry embraces a multiplicity of products, it is, from a practical standpoint, all inclusive. It affects those supply sources essential to equip the airframe with motive power, together with flight instruments, armament, optics and all the equipment necessary to perform aeronautical military, training and transport functions.

Salient contributory features of the Air Corps program are the following:

Basic Industries

Aluminum—First position among the basic industries insofar as it concerns the airframe is aluminum. The average airframe consists of 6,917 lb. and requires raw materials of aluminum and aluminum alloys which constitutes 69 percent of the finished component's weights. Similarly, the aluminum and aluminum alloy raw materials needed for the average engine—including the magneto and carburetor—are 22.6 percent of the total components on the same basis. The aluminum and aluminum alloy raw materials constitute 24.3 percent of the raw material components making up the average propeller.

Steel—The second largest proportion of the airplane's raw material components is steel and its alloys, constituting 28.7 percent for the airframe, 72 percent of the total for engines and 70 percent for the propeller or an average of 2,177.5 lb., 2,366 lb., and 576 lb. respectively. The principal steel requirements are generally alloy steels, involving such alloying elements as nickel, chromium, molybdenum, vanadium and tungsten, all of which are strategic materials.

General Brett

Copper — The principal nonferrous metal other than aluminum are copper and its alloys, bronze and brass. However, only about 2 percent of the weights of the airframe and 4 percent each for the engine and propeller are of copper or copper alloys.

Rubber—Of the airframe 0.2 of 1 percent is rubber, and slightly less than 0.1 of 1 percent for the engine. It should be noted that considerable advance is being made upon a domestic synthetic rubber product and a Standard Oil subsidiary is now erecting a Buna manufacturing plant which will be available this fall.

Magnesium—Less than 1.2 percent of the composite total raw materials constituting the average engine requirements and less than 1 percent of the airframe and propeller requirements are magnesium.

Essential Services

Labor

In the light of the large proportion of the proposed augmented airplane program which represents labor, it is evident that problems of labor availability should arise. Whether this will be a serious bottleneck remains to be seen.

In an analysis of operations in certain plants, notably engine and propeller manufacturers where the proportion of precision machining operations are very high, a considerable difficulty has been experienced in obtaining adequate labor. In order to take care of this condition, apprenticeship or trainee systems have been established. Candidates for apprenticeship training are generally required to be trade or technical high school graduates. As a result of the increased demand for students so equipped, many areas, states and cities have improved their normal training facilities or established them on a sound basis. Notable for its educational foundations

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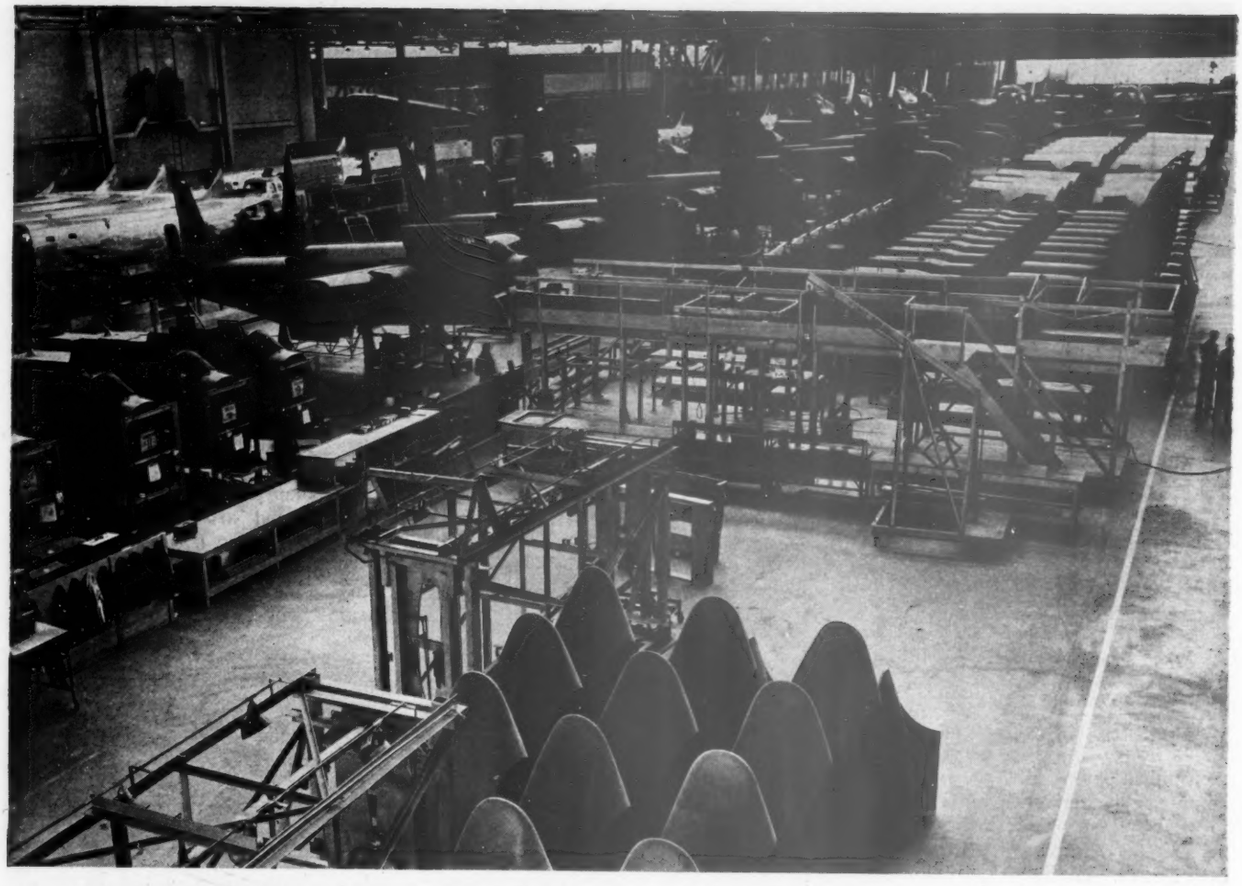
The officer in charge of Wright Field, the Air Corps' proving grounds, is Lt. Col. Oliver P. Echols, center. When a new model has been submitted for consideration he has top say at the field when its being put through its paces. In this conference he is joined by Major F. O. Carroll, left, chief of experimental engineering, and Major A. J. Lyon, materiel division executive.



Douglas DB-7 production line

SPEEDING AIRCRAFT PRODUCTION

By Donald W. Douglas
President, Douglas Aircraft Company, Inc.

AMERICA now faces the emergency for which the aviation industry has long been groomed. This, then, is the hour of destiny for American aviation. If we act wisely and vigorously, under the direction of an enlightened government, and with the full cooperation of our armed services, we cannot fail to meet the need. By proving our capacity to meet any test we have strengthened the hope that the great test of war will never come. Come what may, we are ready. We can do the job. No task is too great and no accomplishment impossible for a free people united in loyalty and love of its country. The aircraft industry is alert, efficient and enthusiastic. It can and will produce the airplanes desired if it is permitted to do its job without unwarranted hindrance from any source. Mere concentration of brick and mortar, of land and buildings, is not sufficient. We must be allowed to have and keep trained personnel, be guided by a clear-cut courageous policy, and be free from restrictions which in the past have hindered and discouraged rapid and economical production of airplanes.

For a long period of years the American aircraft industry has met successfully every design and production requirement imposed. Our civil and military airplanes serve nations throughout the world as well as citizens within our own borders. Our industry has been tempered by time and proved in the fires of adversity. Now that a great emergency program must be met we insist that the aircraft industry be allowed to meet it squarely. We will welcome such assistance as can and must be given by other industries, including the automobile manufacturers, but the aviation industry

insists that the load be placed on its shoulders for planning and producing our expanded air force. Given this load we will carry it, as we have proved our ability so to do.

Aircraft production is a highly specialized problem. While mass production as practised in the automobile industry does not at this time seem likely in construction of airplanes, orders for large quantities of outstanding models will increase the efficiency and technical skill of aircraft manufacturing plants in general and will help build up the backlog of industry's resources and experience. Thus we will prepare ourselves for the last great test if it should ever in future be imposed.

In analyzing our present production problem it is well to consider the military market for which we will be manufacturing. While that market has been lumped under a general figure of 50,000 airplanes, we know that this number of planes, or whatever number it is decided to build, must be divided between the Army and the Navy air forces, each of which has special requirements. The U. S. Army Air Corps alone, under peacetime conditions, operated fifteen different types of aircraft. At the present time there are listed 103 different models of aircraft in use by the Army under these fifteen classifications, or an average of about seven models for each type. It has been suggested that under the new program not more than several thousand of each type will be built annually for each of the services, and that it is unlikely that more than 6,000 planes of any one type would be built per year. No one can say today, certainly not the manufacturers, what types and how many of each type our military experts will deem necessary. Whatever the government needs we can and will build, but no one today can vision 50,000 airplanes of a given type rolling continuously down the production lines of any single plant or in any one locality. Obviously the nation must "recast its thinking" on the subject of mass production of

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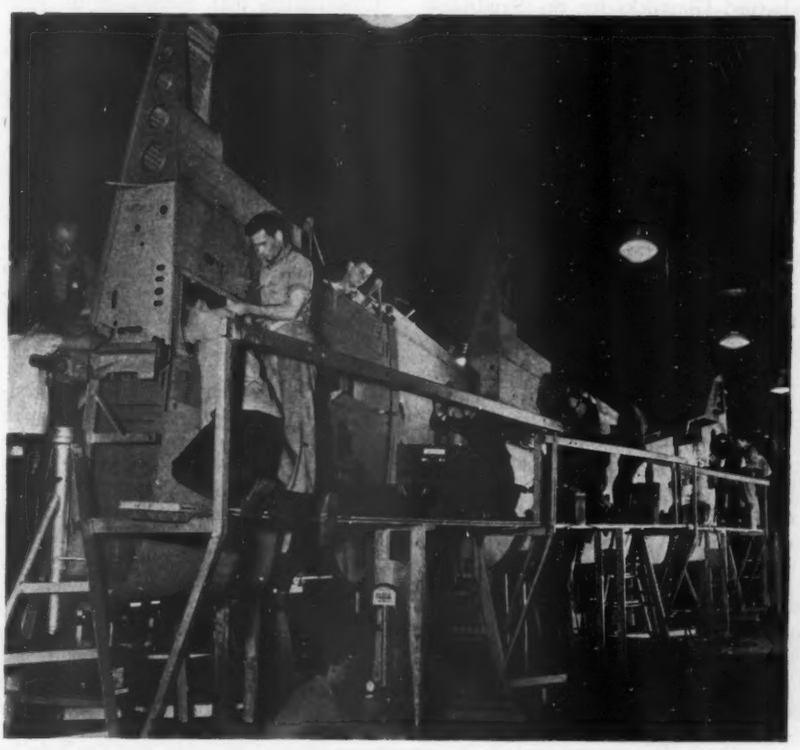


Right, top, part of Douglas inspection department. Every military plane has thousands of parts that must pass rigid inspection. Center, building welded steel tubular engine mounts. This work requires men who have had experience in aircraft welding. Bottom, airplane wing assembly, a complex and tedious job requiring a vast amount of hand labor. Special assembly jigs and tools are necessary. Speed of work is limited by number of men who can work in close quarters.

HOW TO FINANCE YOUR PLANT EXPANSION

By Robert Colborn

Staff of Aviation

MAYBE you are an airplane manufacturer and have just signed the biggest contract you ever saw to make your Sandstorm pursuits for the Air Corps. Maybe you're the man who manufactures the Supercharged Gimmicks for the Sandstorm and are busy negotiating a subcontract. Or maybe you just figure that with all these Sandstorms being built there ought to be a good market for your built-in ashtrays.

In any case, you're going to have to make more than you've ever made before. Certainly you are going to have to install new jigs and dies. Probably you'll need new machinery. Perhaps you'll have to have a new wing or a whole new plant. Your big question is—where do you get the money?

Your first resort, of course, is to your banker. If he will look after you, that's that, but if he can't your thoughts turn to the government.

So far there are three plans available to provide money to firms producing for national defense. RFC will make loans; Army and Navy will make advances on contracts; or the government may put up the money outright. The three plans overlap, and as yet there is no procedure for determining which plan applies to a particular case. In general, the first plan will be the most frequently used. The second, where it is applicable, will be the most generous. The third will probably be used only to the extent that other plans fail.

You don't have to hold a government contract to get an RFC defense loan. If you can convince the Defense Commission that expansion of your plant is in the interests of national defense you are eligible. The first step in getting a loan is to see the nearest RFC loan agency; there are 30 of these throughout the country. You will have to fill out a brief preliminary application, which will be sent to Washington. If you hold a government contract this may be all that will be necessary. You may have to follow up with a formal application containing fairly complete financial information. If all goes well, you may get your money within three weeks; it will probably take longer.

If you are after a government contract, you can start negotiating your RFC loan while you are talking about the sale contract. RFC won't complete the loan until the production contract is signed, but you can get binding, if informal, assurances in advance.

If you aren't a direct government contractor, you will have to get some kind of clearance from the Defense Commission, certifying your project as of defense value, but the procedure on this has not yet been set up.

The kind of loan terms you get will depend a lot on the story you tell. Dealing with RFC is much like dealing with a bank—except that RFC is slower but more generous—and each case is handled separately. There are a few general rules however, and already there is a little experience to go on.

RFC loans carry about 4 per cent interest. They are amortizable over three to seven years. Loan Administrator Jesse Jones told AVIATION that the amortization term will be made to conform to the amortization rates which will be set up when Congress acts on the war profits tax. The President has suggested a term of five years.

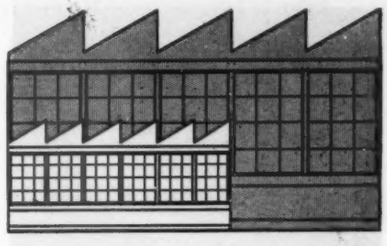
Although RFC officials refuse to commit themselves on the point, it appears to be established that sole security for the loans will be a mortgage on the facilities built with the proceeds of the loan. The borrower does not have to pledge his general credit. This means that if the armament boom blows up in a few years, RFC takes the loss, and the manufacturer is not stuck with a white elephant plant. If this policy is continued, it will probably make private financing relatively unattractive. Some manufacturers will probably set up subsidiary corporations to borrow money and build plants which will then be rented to the parent corporation.

Under the law, RFC can buy stock in defense corporations, but as far as aircraft manufacturers are concerned, all loans will be mortgages, Administrator Jones told AVIATION. There are going to be no management strings on the defense loans, he confirmed.

An exception may be the matter of salaries. The tentative procedure set up by RFC calls for a requirement that borrowers pay only reasonable salaries; some loans have been made without such a provision. Contractors, of course, will find plenty of restrictions in their contracts, and others might find strings dangling from Defense Commission certifications.

A second method of financing is provided by the new authority granted Army and Navy to make advances up to 30 per cent on military procurement contracts. This money is available for either plant expansion or working capital, but indications are that most manufacturers will use the advance for working capital and finance expansions through RFC.

If you are a subcontractor you are not eligible for an advance, but if you go to your principal, he can use your needs as an argument in getting an advance out of the Army or Navy.



The industry is entering its three-fold expansion program. The light area is $ value and floor space today—the dark as it will be.

If you are a contractor, your job in getting an advance is to convince the Army or Navy that you need the money and can't get it elsewhere (elsewhere includes the RFC). You can discuss the matter of an advance at the same time you are negotiating your contract, and you can make the contract conditional on receipt of the advance. You take up the matter first with the procurement officer with whom you are dealing, but you will probably be referred to a special staff being set up to handle advances.

Interest may or may not be charged, depending on the circumstances. In any case, interest will be low. "Adequate" security will be required. This may range from a simple note if the military know and trust you, to a property mortgage or fidelity bond if they don't.

If you have someone on your staff who remembers the old War Credits Board from the last mobilization, he can give you a good idea of how the advances will work. WCB procedure won't be followed in detail, but it's being taken as a point of departure.

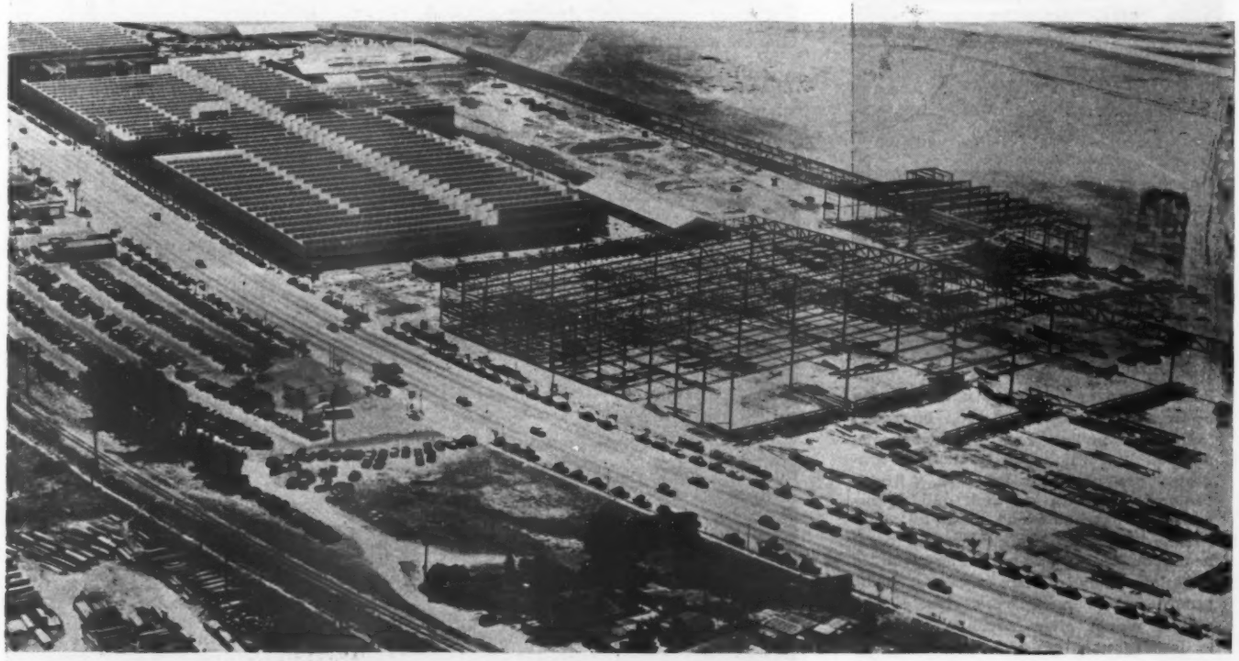
Third, and most hazy, of the financing methods is direct use of government money. Some of this is going to be done, but how and under what conditions is not yet clear. It will not be a subsidy; government will maintain title to the plant. But government will not operate the plant; it will be turned over, under lease or some other arrangement, to private industry. Only example so far is a $30,000,000 smokeless powder plant which Dupont is building, and will operate, near Louisville with federal money.

More than half a billion dollars is available for federal plant construction, and nearly $200,000,000 has been tentatively allocated to airplane and engine plants. If the RFC system works out satisfactorily this may never be used. If difficulties develop, or if the administration goes ahead on its frequently discussed objective of decentralizing the industry, this money may come into the picture.

When you borrow money, you want to know how you are going to pay it back. In this case you won't know until Congress acts on the pending tax law. The elaborate profit-limitation and amortization system set up under the amended Vinson-Trammel law has been thrown out the window because it was holding up contract negotiations. Something to take its place will be in the tax law. Meanwhile, formal contracts cannot be completed and work is going ahead on the basis of gentlemen's agreements.

The ultimate situation can only be guessed at from the rather sketchy plans so far formulated. It looks now as if, in the end, you will find yourself, if you hold a government contract, in a fairly foolproof position as far as plant cost is concerned. You will borrow from RFC enough to set up your plant. Each year you will pay back, say, a fifth of the loan. You will include the payments in your government contract as a cost of doing the work.

Meanwhile, of course, there will be some kind of a limit on your operating profit. How much of your overhead will have to come out of "profit" and how much of a dividend you can finally declare is in the lap of Congress, the President, the Army, the Navy, the Treasury, the Defense Commission, and anyone else that can get his finger in.



The new Consolidated plant is typical of what will take place all over the country, here is a new extension going up.

SUB-CONTRACTING

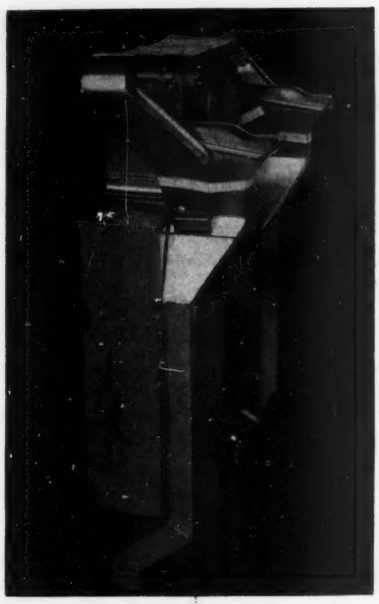
By P. N. Jansen

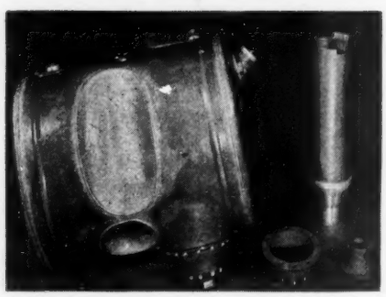
Factory Manager
Curtiss Aeroplane Division
Curtiss-Wright Corp., Buffalo, N. Y.

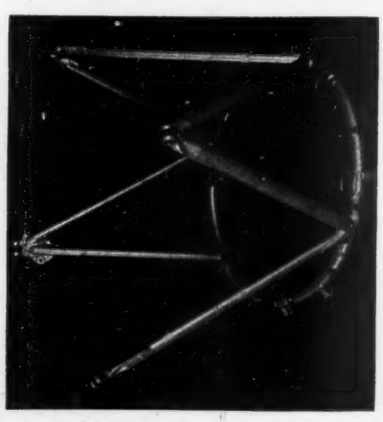
SUB-CONTRACTING is now an important problem for every manufacturer of aircraft. In our great expansion program the basic contract for each type of airplane is between a manufacturer and the United States government. But to speed up production, the manufacturer lets sub-contracts for certain parts of the work. The larger his production order, the more the manufacturer tries to find suitable sub-contractors with whom he can share the additional work.

The general practice for the procurement of materials and parts by the aircraft industry under normal conditions follows a fairly standard pattern. We all buy our raw materials, according to standards for the industry, in a market that is somewhat special because of specifications and requirements peculiar to the needs of the industry. We then buy certain standard, semi-standard parts and assemblies from a much more limited market which consists of suppliers who build strictly aircraft equipment.

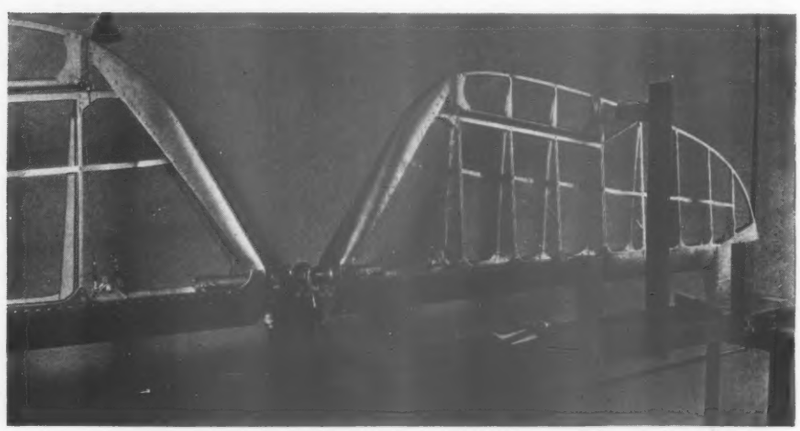
Every industry has its special needs and the so-called open market has lim-



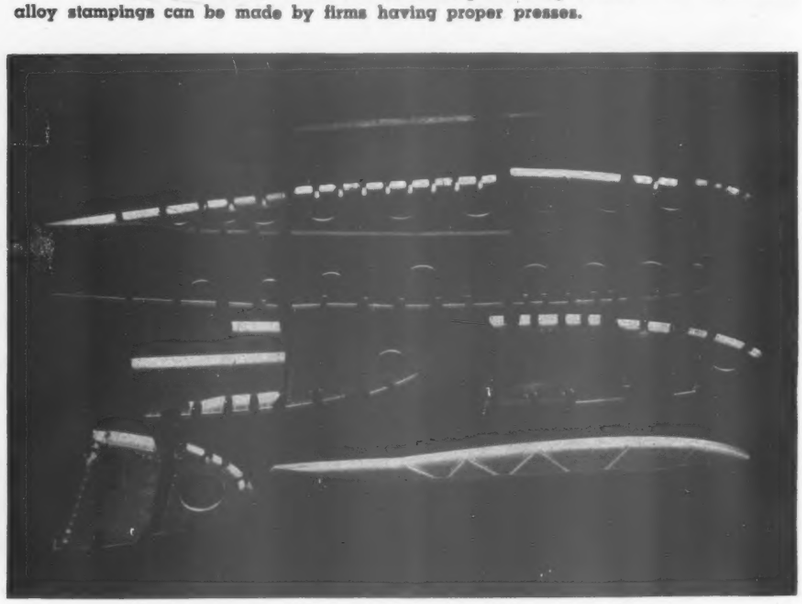




Parts shown on this page can be made by a sub-contractor. At top is a 400 round ammunition box which is complicated but which can be built if templates are carefully followed. Above center is a P-36A oil tank and details which Curtiss has found could be made outside the plant. The engine mount can be made by a sub-contractor who is experienced in aircraft welding. The parent factory must work closely with outside plants, often teaching them how to handle new materials and work to the close tolerances required in aircraft work.



Elevator skeleton of a P-36A which can be entirely made by outside firm. Aluminum alloy stampings can be made by firms having proper presses.



-What and When

itations. Practically all aircraft steel, for example, is made in electric furnaces, as the open hearth will not produce steel of a certain specification to pass the required tests. There is only so much electric furnace capacity in the country, which has, under normal conditions, been quite sufficient. Sudden increased demand simply means more electric furnaces although there may be plenty of open hearth that is idle. The only alternative is a change in specifications and quality in order to permit the use of existing idle capacity. However, this has its complications and means change of design and generally an inferior airplane.

P. N. Jansen

Mr. Jansen joined the Curtiss organization 18 years ago, took over the management of the Buffalo factory in 1926, and today is considered one of the outstanding authorities on aircraft manufacturing in this country.

Most other supplies are purchased from sources developed around the aircraft industry. They also have been able to take care of our needs in normal times. This specialization is not only true of the aircraft industry; automobile manufacturers, ship builders and others have their specifications and special requirements and there is a time element and experience factor in changing over from one to another.

Up to a certain point our purchasing policies as to what we buy or make are practically the same and we are confined to the same markets. In the next step there are some differences and each company has its own policy as to what they normally make or purchase. For instance, we at Curtiss generally manufacture our own landing gears, while some other companies buy theirs to their own design or modified to an existing semi-standard. Reasons for these policies are difficult to explain for each case, but usually depend upon local conditions or type of airplane involved.

So far, I have tried to describe what the average airplane company purchases under normal conditions from sources which are somewhat specialized and which meet aircraft requirements. It is my belief that most companies up to now have not regarded any of these purchases under the term of subcontracting as we now understand it.

The term "subcontracting" discussed in this article means the procurement of parts or assemblies, normally produced by the aircraft companies or their normal suppliers, from entirely new sources. The object of such a plan is to take care of a temporary expansion with the least amount of "brick and mortar" and equipment through the use of existing facilities and capacities. The thought is sound, but the extensive application of the plan lacks the one element for which there is no substitute, and that is time.

What can we subcontract for? Is it complete airplanes, larger units, or only sub-assemblies and details? Since programs are tied up with a time limit the experience factor enters into the picture very extensively. To do aircraft work in normal times at the contractor's plant requires cultivation and training of personnel. This is not confined to the man on the bench or the machine operator, but with present day design and manufacturing practices includes a corps of engineers, tool designers, planners, supervisors, or in other words, a well-balanced organization. Regardless of how good drawings may be or how well subcontracting may be controlled, there is always an experience factor to be considered, or in the vernacular, the "know how".

On that basis our first thought for expanding facilities goes to those outside of our own organization who have been cultivated and who, although it may be on a small scale, have known our quality requirements and given satisfactory service. They have been through the school of experience and have graduated. Depending upon circumstances, location, labor market, availability of equipment and space, they should be the first to take on added work. Since we are familiar

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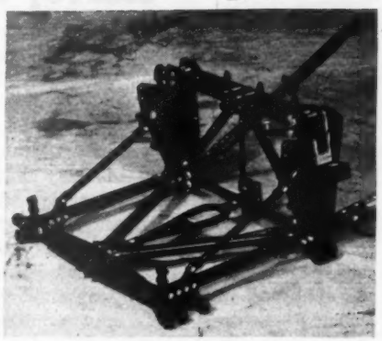


These parts cannot be sub-contracted successfully. Landing gear cowl, top, is better made at home. The unit in the center photograph is a combination of welded and bolted parts that must be accurately made and which takes great stresses. It is best made at home. The three fittings shown just above are complicated parts and must be made to great accuracy.

MOBILIZING Sub-Contracting Facilities

as told to AVIATION by
Harvey L. Williams
Conn. Aeronautical Development Commission

General industry today knows little of aviation manufacturing requirements. This was demonstrated in the experience of the Connecticut Aeronautical Development Commission when it sought to coordinate industrial productive facilities with the requirements of aviation. The plan was launched by Governor Raymond E. Baldwin with the support of Connecticut industry in August, 1939. Details of how it was done are presented here as a guide to other communities which are considering the same problem.

IT is not generally recognized outside of the aviation industry that aviation manufacture is largely an assembly business. It is a bringing together of materials, semi-finished parts, completed parts, completed accessories and completed sub-assemblies (such as landing gears, gun mounts, etc.) which are assembled into completed aircraft. The complete aircraft is composed of the air frame (fuselage, wings and tail services) the engine, the propeller, the instruments, the landing gear and a wide variety of controls, accessories and equipment which vary with the type of plane.

Even in the production of component parts for the finished aircraft, assembly plays a large part. One leading aircraft engine company is reported spending about 60¢ of each sales dollar with its suppliers of parts, accessories and materials. In the manufacture of instruments, increasing quantities of parts are sub-contracted. Instrument cases, dials, springs, hands, etc., are purchased by the instrument maker for assembly into finished instruments.

A large percentage of the man hours used in the production of aircraft for the air defense program will be supplied by industrial concerns outside of the aviation industry in producing the great variety of materials, parts and accessories needed by aviation.

In 1938 and 1939, general industry had not been stimulated by our national defense program or by the war in Europe. In those years the capacity of industry to supply aviation requirements were well in excess of demand. Today, industry is called upon for much new production not related to aviation so that its idle capacity, previously available for aviation products, is declining, while the needs of aviation are expanding rapidly. Combined with the extended delays for delivery of new machine tools, these circumstances create an entirely different situation than prevailed a few months ago—one in which the importance of using every piece of productive equipment now installed, under competent management, to meet aviation requirements is of utmost importance.

Prior to the Spring of 1940, manufacturers who sought sub-contracts from the aviation industry, did so in competition with others seeking the same business. Today, it seems likely that the situation will reverse itself. Aviation is already seeking diligently for idle machine tools and other productive facilities that can be put into operation to fill its requirements.

It is to the interest of industry to become familiar with these requirements and to make any idle or partially used productive capacity available to aviation. The business can be done on a profitable basis. Much of it can be done in moderate sized or small shops, as well as in large industrial concerns. It is business which can be expected to continue even though war in Europe reaches an early end. The commercial development of aviation, both in this country and abroad, with our own national defense program, is expected to keep our aircraft industry busy for some years to come. The potentialities of commercial aviation are far beyond general public knowledge at present. An indication can be had from the statement of one airline president that carriage of all first class mail (instead of only airmail) would require a tenfold increase in aircraft operated by his company.

Aside from the commercial viewpoint of entering a new market with profit possibilities, industry must become aware of its importance to the aircraft program if the national defense plans are to be carried out expeditiously.

The experience of the Connecticut Aeronautical Development Commission has demonstrated three factors which are valuable guides to broadening the coordination between the aviation and other types of manufacturing organizations.

First, it was found necessary to educate the manufacturing executives to the problem and its opportunities for them. Second, it was found practical to collect and analyze and centralize data concerning manufacturing plants and machine shops so that representatives of the aircraft industry could use it intelligently and save much time and expense in locating the type of production facilities they require. Third, substantial quantities of production assets were found in the form of machine tools, capable of doing aviation work, particularly in medium and small concerns which had not been surveyed previously and which would have remained unknown to the

aircraft industry without a centralized effort to inventory their facilities.

The aircraft industry has been glad to avail itself of this assistance when it became convinced that these efforts recognized the practical problems of sub-contracting and that the Commission sought to coordinate available manufacturing facilities with aviation requirements by attempting to aid *both* the aviation industry and the local manufacturer.

Governor Baldwin's plan to co-ordinate the productive facilities of Connecticut manufacturers with the growing needs of the aircraft industry through the work of the Connecticut Aeronautical Development Commission, commenced in August 1939. It was conducted for the next six months under conditions where the manufacturing facilities available to aviation exceeded the requirements of the aviation industry. Despite that fact, new relationships were established between aviation manufacturers and over forty Connecticut machine shops or industrial companies, many of whom had not been aware of the opportunity to sell to the aviation industry. Since the extension of aircraft manufacturing through our own national defense plans, the Commission has altered the character of its efforts. Today it is placing more emphasis on the preparation of a complete and accurate inventory of idle machine tools and other productive facilities than upon the negotiation of business relationships between aviation manufacturers and Connecticut industrial companies. The purpose of this new effort is to create in a single place the detailed information which representatives of aviation manufacturing companies will need to ascertain whether there are in Connecticut production facilities to meet particular requirements. This new effort recognizes that availability of machine tools in several plants, in the same community or within reasonable distance of each other, may make it possible for a group of operations to be routed through a combination of plants when it would be impossible to find one organization able to carry the work to completion alone.

Governor Raymond E. Baldwin of Connecticut, who has made a common sense approach to the problems of re-employment and of encouraging industry.

ONE of the most important considerations is to awaken realization on the part of industrial executives of the extent of the needs of the makers of engines, airplanes, instruments, aviation accessories and equipment. Although Connecticut is the home of the Pratt & Whitney Aircraft, Hamilton Standard Propeller and Vought-Sikorsky, and despite the fact that the Connecticut Aeronautical Development Commission publicized aviation's requirements to the people of the State and its manufacturers since last August by radio, newspaper and magazine publicity, by questionnaires to gather data, by personal contact and public meetings, there still come to the Commission office each week representatives of ten or more manufacturing concerns seeking information on the Commission's program. The difficulty seems to be that heretofore no effort has been made to show large and small manufacturing companies the possibility of a profitable market in expanding production of the aircraft for products which they can make. Consequently, manufacturing executives, unfamiliar with aviation, are usually greatly surprised at the size of the industry, at the size of its purchases from other manufacturers and at its prospects for continued growth. Back of this lies the fact that only a handful of people scattered through the vast population of the United States have personal experience with aviation.

Another important consideration in the co-ordination of industry with the requirements of the aviation manufacturers is the manner in which information on industrial productivity is collected. Aviation uses products made of wood, textiles, rubber, plastics, ferrous and non-ferrous metals. Within each of these classifications are many sub-divisions, conspicuous among which are the different metals included in the non-ferrous group and the various alloys that still further diversify this classification. Even among wood products there is the diversity from packing cases for foreign shipment to molded plywood for wings. Therefore, it is important to obtain from industry the raw materials processed in a particular plant, listed in the order of their importance, so that the aviation manufacturer may know in which fields the experience of the industrial concern exists.

Next, it is necessary to know the character of product made by a manufacturing company. If it is already selling to aviation, the nature of such present product is the best indication of its ability to fill further requirements. If it is not selling to the aviation industry the type of product is of even more importance, for its nature indicates the character of engineering, management, plant equipment, labor and supervision or inspection required in present operations. Of specific interest to aviation manufacturers are the tolerances to which an industrial company customarily works. That factor alone frequently indicates the ability of management, labor and machinery to undertake aviation production.

With a knowledge of raw materials and products, a list of productive equipment, particularly machine tools, takes on great significance. It is not sufficient to list these by types, as drill presses, screw machines, etc. They must be listed by makers' name, type, age, size or capacity and condition. With such information the aircraft production engineer can rapidly visualize the potential ability of a plant to complete operations.

THESE facts give a fair picture of mechanical productive ability, but it is of little use without an equal knowledge of personnel. The number employed, the number of shifts operated, and the number and description of engineering and supervisory personnel is essential. It is also important to know whether such labor can be secured locally without taking it from some other manufacturer. In the investigations of the Connecticut Aeronautical Development Commission the following conditions were frequently found.

Some machine tools, well adapted to aircraft work, are used in connection with a manufacturer's present production for only a small percentage of the time. Manufacturing concerns have in

(Turn to page 116)

WE ARE READY

Leaders of the aviation industry tell their plans for national defense.

While the exact nature of our participation in the National Defense Program has not yet been fully determined, we have made plans for the early expansion of our production to ten times our present capacity. Fulfillment of these plans is already under way. We have doubled the area of our flying field, with the purchase of a 160-acre site adjoining our present holdings. This has enabled us to start construction of a runway almost a mile in length, into the prevailing winds. A brick building of 37,500 sq. ft. area now standing on the newly purchased site is rapidly being equipped for production use, and substantial additions to our present facilities, both in machinery and working area, are being rushed to completion.

I have full confidence in the ability of the aircraft industry to meet the nation's defense requirements, particularly through well-planned expansion of capable producers who up to now have comprised its smaller units. A properly equipped air force demands many types of planes for special purposes, in addition to standardized bombers and fighters which can be turned out en masse by large production units. The development and manufacture of these special-purpose aircraft, which in some cases can be adapted from existing commercial planes of proven performance, is a logical function of the smaller and more flexible producers. The entire resources of the Beech Aircraft Corporation are at the command of the government.

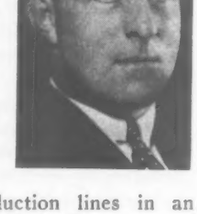
WALTER H. BEECH, *President*
Beech Aircraft Corporation

Our company, being a manufacturer of military aircraft exclusively, is throwing its entire resources behind the national defense program and has guaranteed to fulfill every desire by our government for accelerated production of the Army P-39 (Airacobra) interceptor pursuit plane. We have doubled our floor space to meet the President's wishes for capacity production from the industry and have entered into a two-shift working schedule. We are fortunate in being in a position to redouble this space if necessary, and on a moment's notice, without resorting to new building construction. Our substantial orders now on hand, both foreign and American, enable us to give our own government the benefit of volume production. Although Bell Aircraft is only five years old, it is geared up for high speed production of the modern military fighting plane with the latest equipment and production methods known here and abroad.

LAWRENCE D. BELL
Pres. and Gen'l. Mgr.
Bell Aircraft Corp.

Even a casual analysis of American aviation will disclose that in the past our aircraft builders have been intent on just one thought . . . to manufacture not more, but **better** airplanes. It has been an interest in development and experimentation. As a result, aircraft design and aircraft performance in America have no peer, said LaMotte T. Cohu, Board Chairman and general manager of Northrop Aircraft, Inc.

Continuing Mr. Cohu stated: "To meet the challenge of world air supremacy American aviation will take a second step. Production is the keynote and the American aircraft industry will be paramount in speed of production as well as creative designs. Fortunately we have the plant facilities and trained hands and minds to meet this challenge. All that is necessary now is large enough orders to warrant mass production and Northrop military planes will roll off the production lines in an unprecedented procession."



LAMOTTE T. COHU
General Manager
Northrop Aircraft, Inc.

We are Ready. Give Us the Orders and We'll Give you the Airplanes. The industry has always been able to keep pace with progress and demand. It can do so now. From its own ranks and resources, it can give the national production and the technical leadership second to none in the world. It can, and will, build the most efficient airplanes as rapidly as engines can be provided and materials made ready. Intelligent coordination and unselfish cooperation will set the pace of our national expansion.

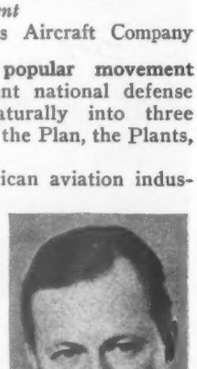
Two months ago I expressed confidence that no task is too great, and no accomplishment impossible for a free people united in loyalty and love of country. I said I knew the American aircraft manufacturers functioning under a free, democratic system, and unhampered by politics and partisanship, will do their share in helping the President and Congress of the United States meet the challenge to everything we hold dear.

On May 16th I said "We can do it." Today I add, "Let us start."

DONALD W. DOUGLAS
President
Douglas Aircraft Company

Any widespread popular movement such as the present national defense program, falls naturally into three principal divisions: the Plan, the Plants, and the Personnel.

While the American aviation industry does not now know with certainty exactly **what** airplanes and **how many** of them the government wants, we feel we have a pretty good idea and consequently, before the echo of the President's message had died away, Lockheed Aircraft Corporation and its subsidiary, Vega Airplane Company, acted in anticipation of our country's needs and were making factory expansions which, by the early part of 1941, will more than treble their present plants.



Further than that, acting on the principle that companies are nothing but men and products only as good as the men who build them, we have opened wide the throttle on our training activities. From past experience we know it is possible to hire and adequately train quantities of job-seekers and in a very short while mold them into an efficient body of result-getting

workers. It has been done before, we are doing it today, and we will continue to do it in the future.

Finally, it is our conviction that there is no reasonable job in aviation that the present companies cannot do . . . because they already have the necessary experience and ability and they can get the "bricks and mortar."

ROBERT E. GROSS
President
Lockheed Aircraft Corporation

Through the years, Grumman Aircraft has built up a compact organization of well-trained men. Our greatest asset is that every man is skilled in his particular job and his morale is high. In a period of expansion, these men will form the nucleus around which new personnel can be trained.

When new orders are received, Grumman can be counted on to do its share for national defense.

LEROY GRUMMAN
President
Grumman Aircraft Engineering Corp.

The vast proportions of the aircraft production program currently being embarked upon by the United States will be a primary challenge to the manpower and brainpower called upon to fulfill the program. New plants must be created, new machinery installed, and tooling expanded. Each manufacturer must determine if he has the supervisory manpower, the key personnel, to do a proper job. Plants, machines, materials —all can be obtained for money. Trained and tested production experts, the "first two hundred" men at the top in any aircraft factory, are invaluable today and they are virtually irreplaceable. Expansion of the staff of experienced executives comes a great deal harder than any other type of expansion.

Republic Aviation believes that it is ready. We are about to begin further expansion of our physical plant properties. We have had substantial machine-tool and materials orders on the books of our suppliers for many months. We are utilizing less-experienced grades of mechanics in our work, training them ourselves to higher efficiency and pay.

We have built our organization from 170 to more than 2,300 employees in less than a year. We have gone from an empty factory to a production of better than one plane per day. The leaders of our present organization were the men who did this job. We are ready to roll, spurred by the confidence which comes from many months of planning, preparation and hard work on a hard job.

W. WALLACE KELLETT
President
Republic Aviation Corp.

Aviation Manufacturing Corporation, through its various aircraft divisions, Lycoming, Stinson, and Barkley-Grow, is in an excellent position as far as plant facilities are concerned, to meet the demands of increased aircraft production in connection with the government's national defense program.

The Stinson Division recently moved into a new million dollar plant at Nashville, Tenn., where some 1,450,000 square feet of aircraft manufacturing facilities are available. This is the first new airplane factory to be completed since the government's enlarged national defense program was announced.

The recently acquired Barkley-Grow Division of Aviation Manufacturing Corporation has its former manufacturing facilities in addition to the former Stinson plant at Wayne, Mich., which it will utilize. These combined facilities will give us considerable space in the Detroit area.

The Lycoming Division now has some 300,000 square feet of factory space. This plant, which formerly turned out a large volume of automobile and marine engines, has been modernized and equipped with new machinery for the manufacture of hollow steel propellers in addition to aircraft engines ranging from 50 to 1200 hp. It, too, is in an excellent position to take care of a considerably larger volume of business. In addition to these facilities, the Spencer Heater Division at Williamsport, Pa., has one of the largest foundries in the United States capable of turning out a tremendous tonnage of various types of castings.

ALBERT I. LODWICK
Vice-President
Aviation Manufacturing Corporation

AVIATION has asked this company to make a statement in reference to the much publicized National Defense Program.

We have made the statement to the proper government authorities that if the Government sees fit to give us a firm order for a tentative number of Army and Navy planes now scheduled, deliveries would be made as scheduled.

We believe the aircraft industry of the United States can produce all of the airplanes required of us by our Government, at a time when the Government is prepared to call upon us and has passed the proper laws and has made the money available for the cost of the program.

GLENN L. MARTIN
President
The Glenn L. Martin Company

Engineers, production experts and workers of the American aircraft industry have developed the art of building airplanes from its infancy to its present high degree of efficiency.

Today the world at large acknowledges the fact that American built airplanes lead in quality of workmanship and performance in the air. These men, with their background of understanding and insight into the problems and techniques peculiar to production in this industry, have already laid carefully projected plans for the future.

With their proven record of achievement they stand ready to produce military airplanes for this nation in whatever quantities are necessary for the defense of our country.

Vultee Aircraft, Inc., as an integral part of this industry, has already expanded its manufacturing facilities and is prepared to do its part in the fulfillment of national defense requirements.

RICHARD W. MILLAR
President
Vultee Aircraft, Inc.

In my opinion the key to successful completion of the tremendous program assigned to the aircraft industry is cooperative endeavor. This involves many people and many agencies—the officers of the Army and the Navy, officials of other government departments, the suppliers of materials, the workers in the factories, the corporate officials at their desks and others.

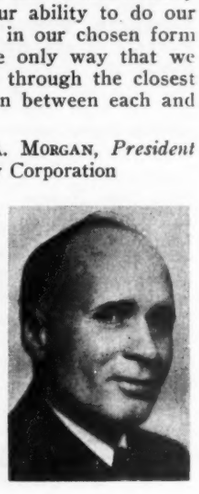
Big business must cooperate with small businesses by farming out

certain operations and assemblies that the small concern can handle. Here lies a great potential productive capacity that is not yet fully developed. And the Congress must cooperate by removing legislation which unnecessarily restricts the operations of the aircraft industry upon which the nation today is so dependent.

A happy key note of cooperation has been struck in the early activities of the Knudsen Commission. Another encouraging sign is the recent appointment of two such outstanding men as Col. Knox and Col. Stimson to head the Navy and War Departments. These moves are heartening to all of us.

We must remember, above everything else, that the fate of this country may depend on our ability to do our assigned job. And in our chosen form of government the only way that we can do this job is through the closest kind of cooperation between each and every party.

THOMAS A. MORGAN, *President*
The Sperry Corporation



Due to the expansion of approximately 500 per cent in physical facilities in the last six months as a result of foreign orders, the Brewster Aeronautical Corporation is in an excellent position to meet the demands of the National Defense Program.

JAMES WORK, *President*
Brewster Aeronautical Corp.

During a period of the past few years the Ryan Aeronautical Company has manufactured and sold approximately three hundred airplanes of the low-wing monoplane military trainer type. We have done this without the benefit of quantity orders or of all the modern production equipment which is available for real line production schedules.

During the past year the Ryan Aeronautical Company has completed a substantial expansion program by which buildings and machinery, equipment and personnel, have been provided for a much higher production rate. We are now doubling existing factory facilities to further step up production efficiency. If given the orders, we can build these trainers in any quantity which may be required to meet the present emergency situation.

T. CLAUDE RYAN, *President*
Ryan Aeronautical Company

Curtiss-Wright is in an excellent condition to play an important part in the President's proposed program to put 50,000 airplanes in service. In the past 12 months we had the actual experience of approximately doubling the engine output of the Wright Aeronautical Corporation, and more than doubling production at the Curtiss Aeroplane Division, and Curtiss Propeller Division. During this period our sub-executives and sub-foremen have been carrying a major part of the load and have been adequately trained in their responsibilities. This leaves us in good shape to continue this expansion rate in other localities under the supervision of our top executives and key men. We feel the proposed Army and Navy program assures the nation of adequate defense in the air and should instill confidence in the American public.

G. W. VAUGHAN, *President*
Curtiss-Wright Corporation

I feel confident that, with Government cooperation and the close coordination of all phases of the National Defense Program, the aviation industry will be found capable of fulfilling its portion of that program. As for Stearman, we are already too busy preparing for whatever part we are to play in that program to say more.

J. E. SCHAEFER, *Vice-President*
Stearman Aircraft
Division of Boeing Airplane Company

At the present time we are operating at 50 per cent of our capacity and have facilities available to produce approximately 600 engines per year in addition to the orders now on hand. Output of our accessory department could be tripled by adding the necessary machine tool equipment. The above figures are conservative and are based on one shift, 40-hour week.

W. O. WARNER, *President*
The Warner Aircraft Corporation

The work of the planning divisions of the United States Army and Navy, as coordinated through the National Defense Committee, and supplemented by their military personnel training programs, subject to Congress enacting suitable legislation along the lines of the policy on the creation of additional manufacturing facilities by private industry, as recently announced by the President of the United States, should result in an effective rearming of the United States in the air competent to preserve our legitimate national interests in any emergency.

J. CARLTON WARD, JR., *President*
Fairchild Engine & Airplane Corp.

There appears no reason why the privately owned aircraft corporations cannot respond to the demands for expanding and equipping the military services. Our industry, however, is disturbed by the delays and conflicting theories of procurement in the Governmental departments. The willingness to cooperate is still expressed but the industry is awaiting the details of a concrete program, free from politics, as to how it may best be of service. Delay in the release of orders is the most harassing difficulty encountered by companies which are questioned as to their ability to provide for the National Defense. As an example, this company at this moment has a year's business already booked ahead, based on last year's production rate, and yet it is now working at only one-half capacity because of delays by others in releasing orders already booked.

EDMUND T. PRICE, *President*
Solar Aircraft Company

In view of the vital importance of aviation to military strength, it is heartening to realize that the American aviation industry is leading the way in gearing for National Defense. United Aircraft is rapidly increasing its facilities to meet the new requirements. The capacity of the Pratt & Whitney engine plant has been tripled, the production of Hamilton Standard propellers is keeping pace. Vought-Sikorsky Aircraft is working at top speed. We are confident that the air craft industry will do its job, supplying the finest airplanes engines and equipment in the world.

E. E. WILSON, *President*
United Aircraft Corporation

Where Should YOUR NEW PLANT Be Built?

EDITOR'S NOTE: Every major aircraft, engine and accessory plant faces an expansion problem today. Either existing factory walls must be pushed out to give more room for production on the same site, or new facilities must be bought or built elsewhere. Because of the amount of recent discussion concerning plant location, much of it based on careless reasoning, AVIATION *presents the following report.*

Many months ago officials in an eastern aeronautical firm foresaw the need for expansion. Should it build a new factory in its own neighborhood, or should it go to a new location? Its engineers began a careful study of all factors that should determine the location of a new plant. When these factors were settled, officials of the plant set out to find a location that most nearly satisfied them.

Plant location is an individual problem. The conclusion reached by this one factory should not necessarily be the logical choice for other factories. But the method used, and the strategic factors that influence plant location, are basic.

OLD definitions of strategy apply only to the positioning and movement of military forces. Bombardment aviation now makes possible destructive military action against industrial establishments. Strategic consideration must therefore be given before and during war time to means of protection of industrial plants by:

I. Their local protection and the local protection of the labor force against demolition bombs and gas bombs.

II. Their general location in relation to possible sources of air attack, and to sources of raw materials and labor.

There are a large number of factors affecting both local protection and general location. Some of these factors are mutually incompatible, demanding a degree of compromise in selecting an ideal location. Obviously, productive efficiency must be considered equally with military protection; a plant location, ideal from a military protection standpoint, would be highly undesirable if the location offered insurmountable obstacles to efficient production. If a plant is important enough in the national defense scheme to require protection, then high production from the plant must also be important.

Considerations in Locating an Industrial Plant

The following list comprises the detail factors influencing the considerations of local protection and general location. As stated before, some of these factors appear mutually opposed:

I. Local Protection
- (a) Protection of plant water and power supply.
- (b) Protection of plant itself from direct bombardment.
- (c) Protection of means of transportation of personnel and materials to and from the plant.

II. General Location
- (a) Distance from possible take-off points of enemy attackers.
- (b) Isolation from other plants, requiring dispersion of enemy air forces in attacking it.
- (c) Location of plant near other plants, enabling concentration of protecting forces.
- (d) Location of plant in a general industrial area, providing good labor market and flexibility of operations in emergency.

Local Protection Factors

For best protection, sources of both water supply and power supply should be at the plant. Thus, deep wells with their openings in the foundation of the plant itself could not suffer damage unless the plant itself was destroyed. In the same way, a diesel power plant, located underneath the plant in a sub-basement, would also be safe from destruction unless the plant itself was destroyed.

It may be noted that the vulnerability of the water and power supply is doubly dangerous in a very large city. Not only are the plant manufacturing operations dependent on the city water and power supply, but the sustenance and transportation of most of the plant personnel. If the water supply of a great city were stopped, the whole city would have to be evacuated. If the electric power for transportation failed, large numbers of people would find it difficult, if not impossible, to get to the plant.

Complete protection from direct bombardment of the plant itself would only be possible if the plant was buried well under the ground. However, local camouflage is possible and is, perhaps, the most effective practicable means of preventing direct hits. The ideal situation would be in the natural protective camouflage of trees and low hills, somewhat distant from a large city, but still within a general industrial area, so that it would not stand out by itself.

Protection of means of transportation of personnel and materials to and from the plant can only be accomplished by locating the plant where a large number of means of transportation makes impossible the cutting off of accessibility. A plant located in the open country where a large number of motor roads afford the means of communication would be the most desirable.

The ability of air attackers to reach their target safely and with an ef-

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NOW WE ARE IN IT

By C. G. Grey

(Founder of "The Aeroplane" and Editor of "All the World's Aircraft")

In view of the interest in wartime developments in Great Britain, AVIATION has arranged to give its readers a first-hand view by C. G. Grey who is already well known to many of you. Mr. Grey has many friends and some critics in this country. For his fans these regular articles will afford an opportunity to enjoy his always entertaining style of writing. For his critics, his writings will provide a target for their brickbats.

WELL, now we are fairly in it. The last time I wrote I said that war might break out at any moment now. It did. Since then we have been in and out of Norway, barring the bit at the top end which we want, presumably so that we can draw our quota of that special breed of iron from the Swedish iron mines which supply Germany through the Baltic when the ice is gone. Even up there German bombers worry us, but now we seem to have some fighters which worry the German bombers. So things are not so one-sided as they were when we came out of Norway.

Also we have been in and out of Belgium. And here is where the Royal Air Force has shown what it can do.

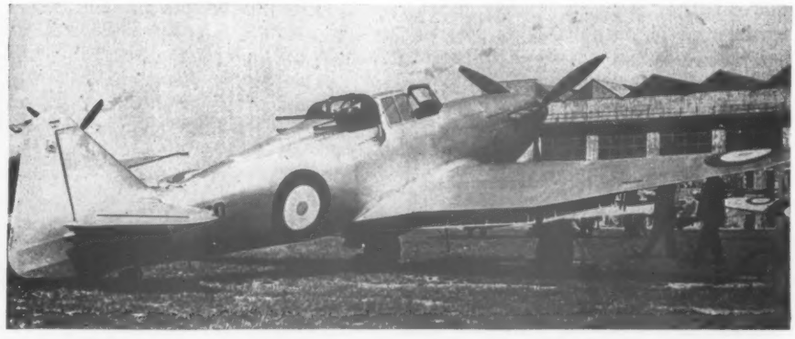
Official statements have been made that we have got four-fifths of the British Expeditionary Force out—330,000 men, including a lot of French and some Belgians. Practically all came out through Dunkerque; hardly any came through Calais, before the Germans captured the town and the harbor.

Some of us are wondering how much of the B.E.F. would have got out of Flanders if we had been as short of fighters there as we were in Norway. The R.A.F. won a great victory.

Probably nobody has explained to the United States why we were short of fighters in Norway. Quite briefly, most of Norway is vertical. If you want to make an aerodrome you have to blast away a mountain, and the Norwegians had not done enough blasting before the war started. The Germans collared the two aerodromes at Oslo, and the aerodrome at Stavanger, and the little landing field at Trondhjem, before we could get there.

That was not the fault of the R.A.F. Somebody else can discuss whose fault it was. Consequently although our troops were able to land in comparative ease North and South of Trondhjem, as soon as they started work they were considerably blasted by German bombers and were finally blasted out of the country.

We did put a squadron of Gladiator biplanes on a frozen lake North of Trondhjem, but the German bombers blasted the ice from under them. The only other fighters available were those of the Fleet Air Arm flown off the Navy's aircraft carriers. And the North Sea, even as far North as that, is not a healthy place for lightly armoured aircraft carriers.



The BoultonPaul Defiant, a formidable weapon which has proved to be a great surprise to the Germans. Its chief feature is its hydraulically operated gun turret, which can deliver a powerful broadside blow at enemy airplanes. Ship is a two-seater. Gunner is captain.

All photographs British Combine

To Americans, the best known British fighting plane is the Spitfire, powered with Rolls-Royce engine, which engine is to be built by Packard.

Lately they seem to be working up at Narvik by the sound process of keeping the ships too far North for the German bombers to reach them, but near enough for their fighters to cover Narvik. Presumably they have their own means for protecting themselves against German submarines, of which, at the moment of writing, we have heard nothing for some six weeks. We assume that they are being saved up for some big attack on our shipping.

The Belgian affair shows what can be done with fighters. We have poured squadron after squadron of fighters across the Channel from British aerodromes, and the result has appeared in the official communiqués. Anything between 30 and 80 German machines destroyed in a day shows what can be done with adequate forces of fighters. Even in its most cock-a-hoop moments the R.A.F. never flattered itself that it could take on German fighters at three-to-one odds as a normal procedure and that it would come to regard ten-to-one as fair odds.

Our people here never underrated the guts of the German fighting man, and the way the Germans have used parachute troops shows that the Germans have plenty of courage. Where the R.A.F. has scored is, I am pretty sure, in experience, quickness in snatching opportunities, and what one might describe either as war-worthiness or the Cavalry Spirit.

In the last war, although the Germans had some of the finest individual fighting men in the air, our people found that in the mass the German pilots did not like man-to-man combat. They preferred working in masses.

We found just the same thing on the ground. The ordinary English soldier could extemporize where the German went flat if he had no instructions for the particular emergency which met him.

One of the surprises of the war has been the superiority of our eight-gun fighters, the Vickers-Supermarine Spitfire and the Hawker Hurricane, over the Messerschmitt 110 twin-motor canon-carrying fighters. That has been followed by a still greater surprise in the success of the Boulton-Paul Defiant.

This machine was built to please a section of the Air Staff which had its own theories about air fighting. Hitherto, as everybody knows, though there has been little discussion of the subject, the pilot of an aeroplane has automatically been the captain of the ship. In a single-seater he is captain and crew as well. But in a two-seat fighter he has had his guns in front and has fought the ship so as to bring his own guns to bear and

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Although not of recent vintage, Gloster Gladiators have been able to get in some effective work. Power is from a Bristol Mercury IX.

How to Get CAA Training

By Blaine Stubblefield
News Editor, Aviation

"IF you're curious about this new force, aviation, and its possible effect on your future, first learn to fly. The first 35 to 50 hours are most important, so learn via the controlled method; from there, anywhere." So says an official of CAA's training section.

If you are already a private or commercial pilot, or an instructor, CAA offers courses that will "standardize" you for re-rating under Civil Air Regulations.

First, if you're less than 18 years old, forget it until you are. If you're 40 or more, forget it until the highly improbable day when we are in a terrific war and have used up all the younger men. There are plenty of grade A flyers who are 50 or more, but a pilot's life doesn't usually *begin* at '40.

We've learned lessons from recent events. Any reasonable preparedness will require thousands of men who can take the air. It is unofficially estimated that to insure successful defense, with an airplane production capacity of 50,000 planes, we will need a pilot force of 150,000, plus a ground force of 150,000 mechanics and service men.

The Authority plans to train a total of 87,000 during the fiscal year beginning July 1, 1940. About 45,000 of these will be stick-and-rudder experts, starting from "when I push the stick to the right, the right wing goes down." About 10,000 will be secondary students, taking additional CAA training. Twenty-five hundred commercial pilots will be given instructors' courses, so they can serve the CAA schools; 17,000 active and inactive pilots will get refresher courses and 25,000 graduates of CAA standardizing courses will be given syllabus training.

A few important general facts you should know: there is no charge at all in connection with courses being offered between June 15 and September 15, 1940. The government pays for your insurance, and it pays the fee for your physical examination if you pass. If you fail to pass, *you* must pay it. The medical fee is $6. Of course, you will pay your own transportation and living expenses. Women are accepted for training in the preliminary courses, but only one to each 14 men. The Authority wants women to fly, but it cannot spend much government money teaching them, because public opinion would not permit them to take part in military operations.

Do not count too strongly on being hired by the air transport industry, or on being taken into the Army or Navy air arms just because you graduate from a CAA training course. Thousands of graduates will be able to make flying careers for themselves, but most will not. You can look forward with reasonable certainty, though, to being able to fly your own plane or "keeping your hand in" through "refresher" courses offered by the government.

All applicants must be citizens of the United States. No aeronautical *engineering* training is provided under this program. Such courses can be obtained at some of the larger colleges, and to some extent at certain commercial air schools. No aviation mechanics training is being given by CAA, but a list of approved commercial aviation schools, offering flying and mechanic courses will be supplied on request to the Air Corps, War Department, or the Bureau of Navigation, Navy Department, Washington. For those students who require it, part time training in the CAA ground and flight training can be arranged in some cases.

This is how the CAA program is set up. Congress appropriated money to the Civil Aeronautics Authority, which is in charge of the training. CAA enters into contracts with schools and colleges of many kinds, to give the instruction. The educational institution itself gives the ground-school work, and it designates fixed-base airplane operators or air schools to give the air work. The institution is required to pay for accident insurance and hospitalization coverage for each student, which protects him while on his way to and from, and on, duty.

The flight contractor is required to provide one approved instructor for each 15 students, and one certified aircraft of not less than 50 hp. for each 10 students. Flight contracts are limited to a maximum of 60 trainees per operator per airport.

Now there are four general kinds of training offered: (1) pilot training courses; (2) instructor courses; (3) pilot refresher courses, and (4) pilot "syllabus" courses, which give you time in the air to keep your pilot certificate active.

Pilot training comes under two heads: preliminary and secondary. You

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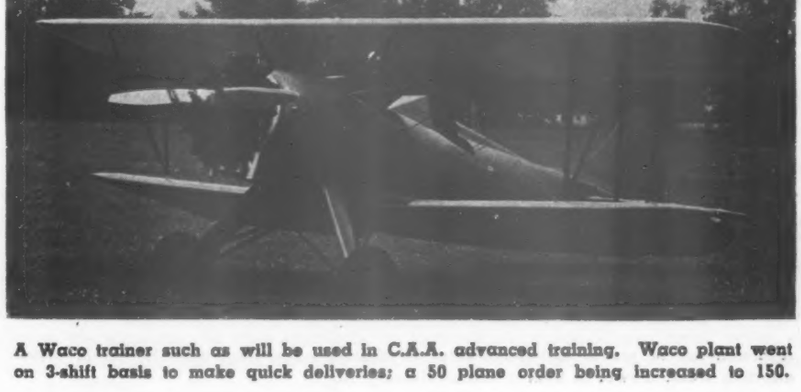

A Waco trainer such as will be used in C.A.A. advanced training. Waco plant went on 3-shift basis to make quick deliveries; a 50 plane order being increased to 150.

Aviation Earnings Regulated

By Selig Altschul

A FUTURE pattern for economic regulation of the air transport industry may well have been established by recent decisions of the Civil Aeronautics Board.

The decisions pertaining to United Air Lines and Western Air Express have important implications. In reversing Examiner Roscoe Pound's able report by denying United's application to acquire Western Air, the C.A.B. appeared concerned with the consequences of monopolistic control and sought the maintenance of a state of competition among the air carriers.

When it is realized, however, that United attained its main objective—an eastern entrance into Los Angeles—by the device of interchanging sleeper equipment with Western Air Express, the premise of the C.A.B. decision becomes very tenuous. Moreover, it is questionable whether or not the added expenses incurred in the interchange of equipment is conducive to sound and economical development of the industry. In any event, the practical investor can appraise United's competitive position as somewhat improved and Western Air becoming the main beneficiary.

The decision pertaining to the interchange of equipment has one more interesting aspect. Why, for example, cannot American Airlines seek to operate a through coast to coast service over its route from New York to Chicago and thence to Seattle via Northwest Airlines? The principle of interchange of equipment, an old railroad custom, has at least been established in the air transport industry, and where it may lead remains to be seen.

Although denied permission to purchase Marquette Airlines, Transcontinental & Western Air may yet be able to acquire this desirable feeder. The C.A.B. conceded the advisability of TWA acquiring Marquette and the improved service that would result therefrom. Moreover, the C.A.B. took pains to observe that TWA, by operating Marquette, would have plenty of competition and enjoy no monopoly in the territory served. What the C.A.B. did object to, and upon which its denial was based, was the purchase price of $350,000 for a business whose physical assets were valued at about $30,000. Obviously, the line's certificate of convenience, for the most part, was evaluated at the balance of the contract price. The Board held that such a certificate should not be used as a speculative security and transferred at inflated prices. This decision has a sound economic basis and may well avert certain unfair and detructive competitive practices within the industry. There is no justification to lump certificates of convenience and necessity in the same category as whisky warehouse receipts to be traded, bought or sold.

Yet, the certificate of convenience and necessity is an airline's most valuable asset. Without such franchise, an air transport company is powerless to operate. What is a fair price for such a certificate when a transfer is in the public interest? This is one of the intangibles for which no clear-cut formula is yet available. It is this nebulous attribute, among others, that will probably clothe air transport securities with a speculative tinge for some time to come.

The C.A.B. decision pertaining to United's air mail rate structure may have important significance in that it is the first rate decision dealing with one of the major transcontinentals. United had petitioned for mail compensation based on the pound-mile method of computation. Instead, the C.A.B. continued the present airplane mile basis, abolished weight-credit trips and computed the rate upon the basis of all miles flown with air mail.

Retroactive compensation for the twenty month period, October 27, 1938, to June 30, 1940, was also granted, and should mean about $288,000 in back pay for United.

The air transport industry continues to record new highs in both traffic and earnings. Preliminary reports indicate that the domestic air transport industry as a whole earned more than $2,000,000 during the first half of 1940, compared with less than $500,000 for the like period in 1939.

American Airlines earnings for the quarter ended June 30, 1940, are estimated at about $600,000 after all charges and taxes, equal to about $1.65 per share on 357,500 shares now outstanding. This would compare with earnings of $304,053 for the first quarter of 1940 and $379,296 or $1.30 per share on 293,746 shares outstanding in the second quarter of 1939.

Estimates place second quarter earnings for Eastern Air Lines at about $200,000 after all charges and taxes, equivalent to around 35 cents a share on 554,948 shares currently outstanding. This would compare with earnings of $551,579 earned in the first quarter this year and $130,291 or 31 cents a share on 418,736 shares reported for the second quarter in 1939.

United Air Lines is believed to have earned about $500,000 after all charges and taxes, or 30 cents a share on about 1,500,000 shares outstanding, in the second quarter of this year. Such results are without benefit of the retroactive mail award recently received. The company showed a net loss of $288,175 in the first quarter of this year and earned a profit of $216,123, or 14 cents a share, during the June quarter of 1939.

Transcontinental & Western Air, contending with added costs due to the expansion of its services and the introduction of the Stratoliners, has yet to attain profitable operations this year. The company is believed to have lost $50,000 in the second quarter of 1940, compared with a net loss of $391,458 reported for the first quarter of this year and a net profit of $8,974 in the second quarter of 1939. TWA, however, has made rapid strides in its passenger traffic and may be expected to reverse its previous

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Averages

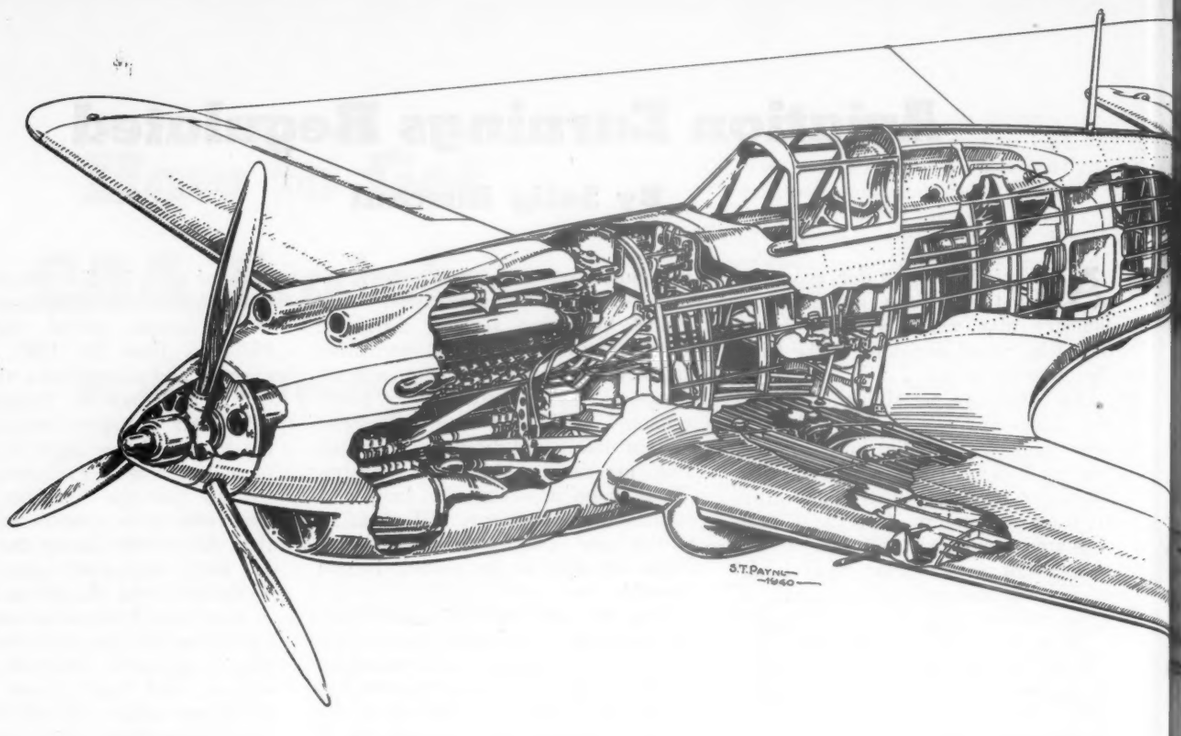
		Barron's Aircraft Average	Barron's Air Transp't Average	Barron's 50 Stock Average
June	14	38.58	25.38	69
	21	35.48	26.69	71
	28	34.18	27.91	70
July	5	33.00	28.03	71

TABLE I

Actual and Adjusted Earnings Possibilities for Selected Aircraft Companies

(Based on 1939 results)

	Actual			Assumed	
	Profit (000)	% on Sales	% on Invested Capital	Net at 5% on Sales (000)	% on Invested Capital
Consolidated	$1,104	30.6	19.0.	$180	3.1
Curtiss-Wright	5,218	10.7	15.0	2,433	7.0
Douglas	2,147	7.6	19.8	1,417	13.1
Lockheed	3,133	8.9	35.4	1,765	20.0
Glenn L. Martin.	4,111	17.0	22.9	1,208	6.7
North American..	7,088	25.7	74.0	1,380	14.4
United Aircraft..	9,375	18.0	28.8	2,604	8.0



NEW CURTISS P-40

The important role this ship will play in our expansion program has brought it wide attention

ONE of the important items in the new defense program is the building up of our single seat pursuit type airplane. In this classification falls the Curtiss P-40 and it is probable that this type will be one of the mainstays in the pursuit expansion program.

At present the Curtiss Aeroplane Division in Buffalo is actively engaged in turning out more than $14,000,000 worth of these ships as part of a record peace-time order awarded during 1939 by the War Department. Types similar to these have also been ordered by England and may see a great deal of action before long.

The P-40 has been the outgrowth of the familiar long line of Curtiss Hawk airplanes. One of the most prominent recent versions has been the Hawk 75A, the export version of the Army P-36. The XP-37 was also a Curtiss design and was one of the first ships to use the liquid cooled Allison engine. Shortly following this came the P-40 with increased speed and performance. Although performance figures on this ship are still withheld it is interesting to note that a P-36, a slower plane, was flown from Dayton, Ohio, to Buffalo, New York, a distance of 360 miles, in a total elapsed time of one hour one minute at an average speed in excess of 350 miles per hour. It was this same model which has received such favorable comment on its record during the French participation in the war.

The P-40 was delivered to the Materiel Division of the Air Corps just in time to be flown to Bolling Field where it was shown to the President. It made such a favorable impression during the demonstration that the large order was placed which is now under way in Buffalo. The same group of engineers that had charge of designing the P-36 had control of designing the P-40.

Releasable information concerning the ship is still rather limited. However in the next few paragraphs is listed all that is available at this time.

Type

Single seat pursuit plane.

Wing

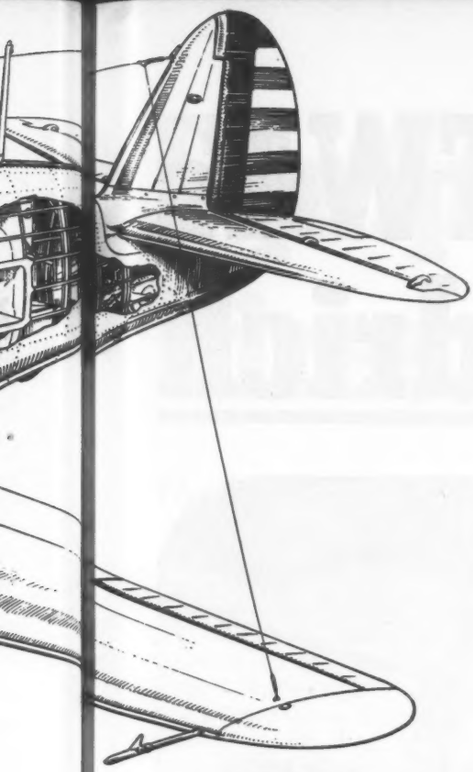
Low wing cantilever monoplane. Structure consists of longitudinal stringers, shear beams and bulkheads of aluminum alloy flush riveted to smooth Alclad skin. Aluminum alloy framed ailerons are fabric covered. Split trailing edge flaps extend from center of fuselage to aileron.

Fuselage

Aluminum alloy monocouque structure flush riveted to smooth Alclad skin.

Tail Unit

Cantilever monoplane type. Fixed surfaces have an aluminum alloy frame



covered with sheet of the same metal. Movable surfaces are metal framed and fabric covered.

Undercarriage

Fully retractable type with wheels swiveling 90 degrees, to lie flush in the wing panel. Curtiss oleo pneumatic shock absorbers standard equipment. Aluminum alloy fairings on struts. Tail wheel completely retractable and steerable.

Power Plant

One Allison V-12 liquid cooled inline engine equipped with integral supercharger to Air Corps specifications.

Propeller

Three-bladed Curtiss electric constant speed propeller standard equipment.

Accommodations

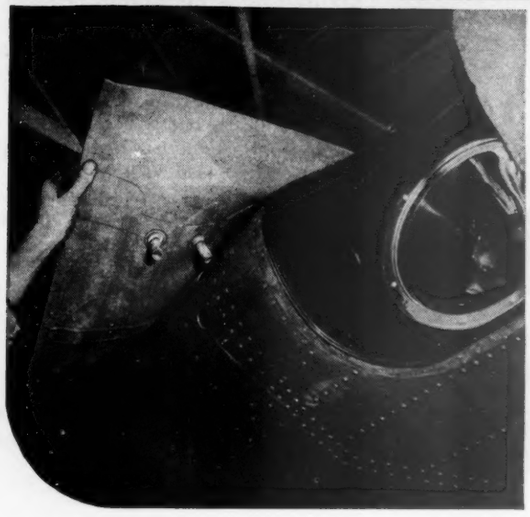
Inclosed cockpit with sliding top. Heating and ventilation are provided.

Armament and Equipment

This plane is equipped as a normal fighter in accordance with U. S. Army Air Corps specifications.

Flying Equipment

Year After Year TWA's Specify Goodrich



"DRESSED" FOR WINTER

★

Long before winter starts, TWA planes are "dressed" for it. Wing edges get the protection of Goodrich DE-ICERS shown at the left. Note the tubes through which DE-ICERS are automatically inflated and deflated, loosening and lifting ice so that the wind can sweep the wing edge clear.

★

In winter TWA propellers take on the protection of the "spinner" and "slinger ring" assembly . . . the ingenious Goodrich development that constantly bathes propeller blades with a solution that defies ice formation.

Equipment Programs Tires and DE-ICERS

Thousands of Travelers Who "Go TWA" Go With Goodrich Protection

AS ONE of the nation's pioneer air lines, TWA has performed a major service in convincing America that "it pays to fly."

TWA laid this early groundwork solidly . . . with fast, convenient schedules and luxurious accommodations . . . with safety kept at its highest peak. TWA's strict attention to equipment is clearly demonstrated by the fact that Goodrich Airplane Tires have always been in its service. And along with its policy of "Selected Route Flying" in winter, TWA also protects planes and passengers with the all-important Goodrich DE-ICERS.

Many of the world's leading air lines, plane makers and pilots measure the service they've had from Goodrich Aviation Products not only in thousands of flight miles but in actual *years* of service . . . from Goodrich Airplane Silvertowns . . . Goodrich DE-ICERS . . . E.T.* Brakes . . . and over 40 other products. Get in touch with The B. F. Goodrich Co., Aeronautical Division, Akron, Ohio, for complete information about these products for all sizes and types of planes.

*Goodrich Expander Tube Brakes are manufactured under license and sold by Hayes Industries, Inc., Jackson, Mich., and Bendix Aviation Corp., South Bend, Ind.

TO JACK FRYE, president of TWA, congratulations from Goodrich! A young, progressive, far-visioned executive, he has contributed much to aviation. From the early days of commercial aviation, when schedules were few and far between until today when TWA Douglas Transports fly the skyways every hour of day and night, Jack Frye and the company he directs have devoted themselves to the purpose of making air travel safer, more comfortable and more dependable for all who fly.

GOODRICH Airplane Silvertowns, like all other TWA equipment, get "eagle-eyed" inspections between flights. It is these huge low-pressure Silvertowns that give safe, smooth landings to the Gold Coaster . . . Sky Chief . . . Sun Pacer . . . and other famous TWA planes.

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ARMY PHOTOGRAPHIC SHIP

FOLLOWING an announcement recently of the War Department there began the first flying tests at Wright Field, of a new departure in a specially-designed Beechcraft photographic plane. This is the first such plane which will carry the tandem camera installation of two T-3A cameras taking a tandem mounting. The first of two fleets of Model 18S twin-engine Beechcrafts—designated by the Army Air Corps as Type F-2, in their conversion for photography purposes has been delivered. These planes are produced by the Beechcraft Aircraft Corporation, Wichita, Kansas, to which a contract totaling $528,749.00 had been awarded.

Powered by two Pratt & Whitney 9-cylinder radial engines, rated at 350 H.P., using a two-bladed propeller of a little more than 8 feet in diameter, this all-metal, low-wing monoplane has a wing span of 47½ feet and carries no armament. Its gross weight is approximately 7000 pounds and holds a crew of pilot, navigator and photographer. Its ceiling may be placed at above 25,000 feet.

Equipped to carry cameras for photographing and mapping missions it carries, for tactical mapping, the Fairchild T-3A tandem camera and probably the Fairchild K3B for oblique shots from the sides of the fuselage or pictures taken through the roof. For certain reconnaissance missions these may be replaced by the 24-inch focal length K7C for the tandem installation. Thus, whether it be for rapid reconnaissance mapping, tactical mapping or for high altitude mosaic and spotting purposes the F-2 plane is adapted to the employment of any indicated type of camera.

In its original try-out at Beech Field the Beechcraft, after thorough tests in all characteristics of structure and performance, was accepted by Air corps representatives and piloted from there to Wright Field, some 735 miles, by Capt. Russell Kiellor in 3 hours and 38 minutes despite cross-winds of 40 to 70 miles per hour velocity.

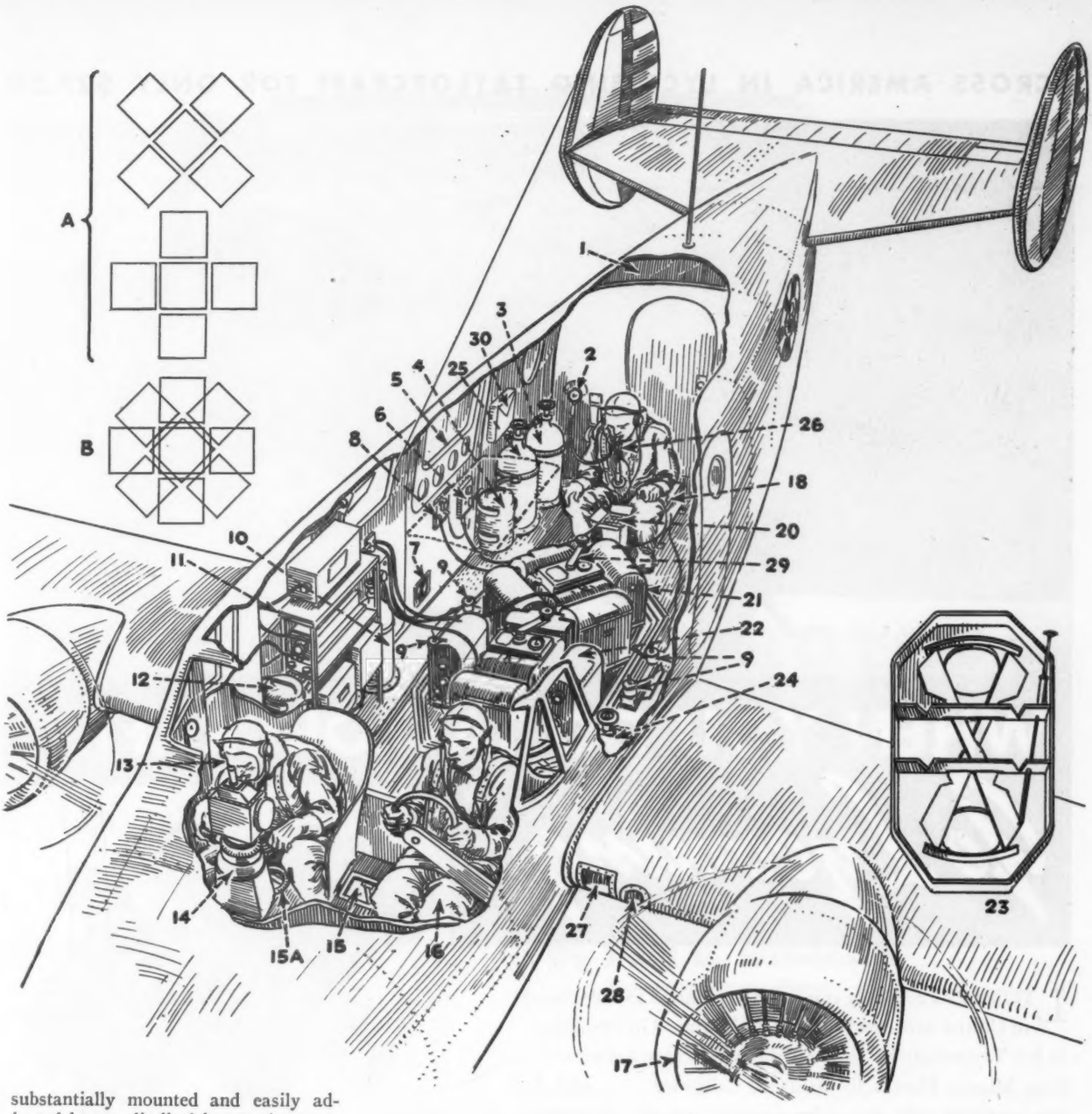
The design of the F-2 is such that maximum visibility is assured to both pilot and photographer and an advantage is secured in the facility with which take-off and landing can be accomplished on the relatively small airports frequently used in the mapping of mountainous areas of the United States. Incidentally, a strap attached right and left of the "dark room" door enables the photographer to secure himself in take-offs and landings.

Taking picture with single lens camera through roof aperture

The immense employment of aviation in the current war in Europe conclusively proves the imperative need of accurate understanding of the enemy's terrain and the disposition of man-made works and troop or artillery dispositions, and the success of the bombing mission is in direct proportion to the excellence of the preliminary photographic mission. With the F-2 the United States Army is provided with a rapid, easily-maneuvered, well-equipped means of observation. Radio equipment—including a commercial set—completes the necessarily important liaison between ground and plane. An interphone system utilizing the throat microphone principle, is installed. In the drawing the photographer is shown with his left hand grasping the device holding the microphone button—which is held down in the act of talking. A bracket on the wall to the man's right holds this instrument when not in use. To the navigator's right is a hand-controlled transmitter. Oridinarily talking between photographer and navigator occurs only between the taking of the pictures.

Between the photographer's knees is his view finder, rotatable in azimuth, which, with its ample-sized field, grid and bubble, enable him to maintain a constant check on "crab" and overlap. From the box on which he sits—the source of the "electrical surge"—comes the power which actuates the ten magnets which trip the shutters of the ten individual cameras.

Outstanding, in equipment, is the navigator's gyro-stabilized drift meter,



substantially mounted and easily adjusted by a cylindical bar to the operator's right. Immediately behind, on the floor, is a six-inch aperiodic compass.

To the right and left of the photographer and above in the roof are detachable sections into which a species of rubber-covered yoke can be affixed. Against this the single-lens camera may be thrust and firmly held while oblique pictures are taken. The roof opening permits the photography of subjects such as flight formations, overhead, where a clear vista is demanded. In the "dark room" this single-lens camera may conveniently be stored or films changed.

High altitude flying is promoted with oxygen drums, two to a man, and the discomfort from cold reduced by

(Turn to page 146)

A—Upper left hand corner. Pattern of exposures as taken with fore and aft units of T3-A cameras.
B—How combination secures greater ground coverage at time of exposure.
1—Darkroom and stowage of single lens camera
2—Oxygen outlet
3—Oxygen drums
4—Photographer's parachute
5—Window may be opened for taking oblique pictures
6—Outlet to headset
7—Heat intake
8—Outlet to microphone button
9—Fore and aft levelling for tandem camera
10—Oxygen drums
11—Radio equipment
12—Navigator's parachute
13—Navigator Gyro-stabilized drift meter
14—Gyro-stabilized drift meter
15—Aperture enabling pilot or navigator to see ground
15a—Aperiodic compass
16—Pilot
17—350 H.P. motor
18—Switchbox with wire connections to camera shutters
20—View finder
21—Aft camera unit
22—Forward camera
23—Type of door used in bottom of fuselage beneath camera units. Can be opened and closed
24—Oxygen drum
25—Aperture in roof permits photography from an upper level
26—Throat microphone
27—Oil cooler
28—Cockpit cooler
29—Crank to wind film
30—Data case

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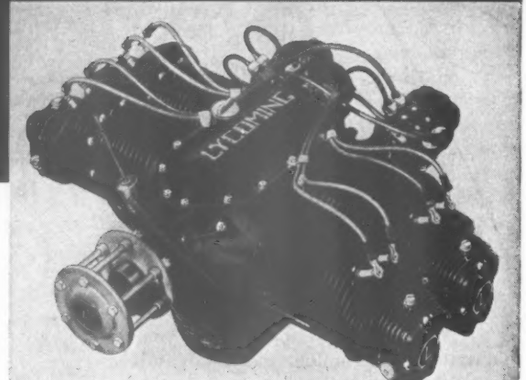
SEND FOR FREE LITERATURE: Illustrated folders on Lycoming lightplane engines may be obtained from all Taylorcraft, Aeronca, Luscombe, Piper Cub or Porterfield dealers. Or write Dept. A840, Lycoming Division, Aviation Manufacturing Corp., Williamsport, Pa., U. S. A. Cable address: Aviatcor.



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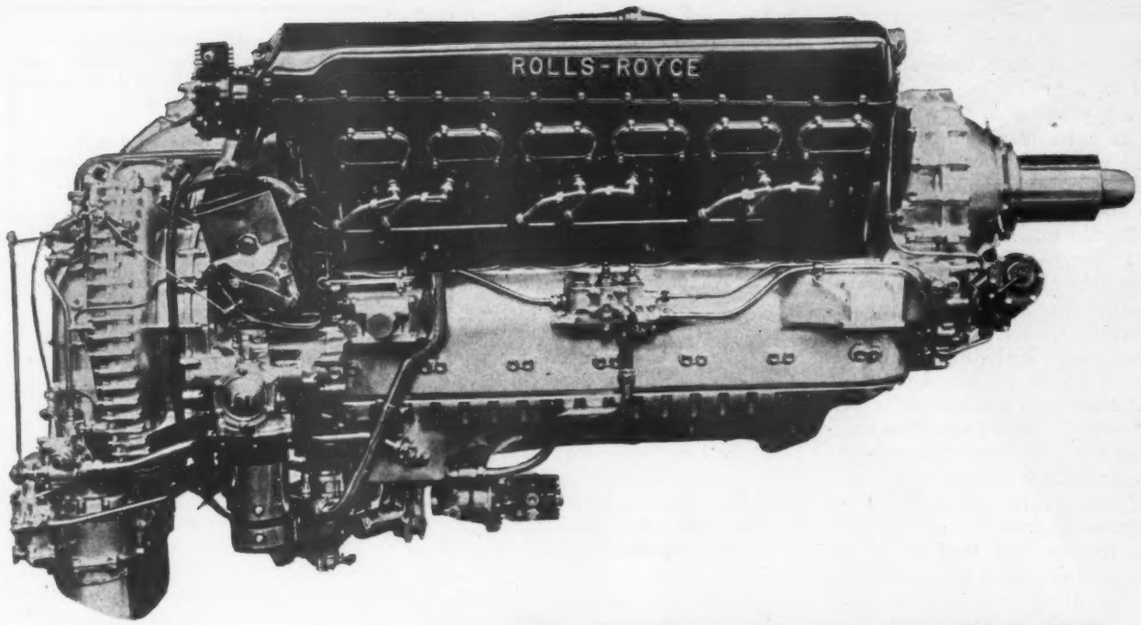


ROLLS-ROYCE MERLIN

The engine for which the Packard automobile company has accepted a contract and is tooling up for production in Detroit

By Paul H. Wilkinson
Consultant, Diesel Aviation

THE proposal that one of our leading automobile manufacturers should tool up for the production of thousands of British Rolls-Royce Merlin aircraft engines has recently received considerable prominence in the press. Apparently the designs and patents of the Merlin are to be made available to us provided we undertake to build 6,000 of these engines for Great Britain and as an afterthought, 3,000 of them for ourselves. So far, the Ford Motor Co. has considered the proposition and has declined to build the Merlin for export in this manner. Now the order has been taken by the Packard Motor Car Co. which appears anxious to tackle it but has not released any definite plans on exactly what they are going to do.

From the aeronautical point of view the Merlin is beyond reproach. It has established an excellent reputation for itself in the high-performance interceptors of the Royal Air Force such as the Hawker Hurricane and the Supermarine Spitfire and two-place fighters such as the Boulton Paul Defiant. It has also been used with considerable success in light bombers such as the Fairey Battle and heavy bombers such as the Armstrong Whitworth Whitley. For this reason, it is claimed by our government experts to be a highly desirable engine in the rearmament of the air forces of the United States.

Several models of the Merlin have been produced since it was placed in service in England four years ago. For instance, the Merlin II with its one-speed supercharger has a rated output of 1,030 hp. at 3,000 r.p.m. at 16,250 ft. and a take-off rating of 880 hp. on 87-octane gasoline. When using 100-octane gasoline, its take-off rating is increased to 1,000 hp. Another model, the Merlin X, is equipped with a two-speed supercharger and develops 1,010 hp. at 3,000 r.p.m. at 17,750 ft. and 1,075 hp. for take-off when using 87-octane gasoline. A third model, the Merlin RM.2.SM, is designed for operation on 100-octane gasoline and is rated at 1,145 hp. at 3,000 r.p.m. at 16,750 ft. with 1,300 hp. available for take-off. All of these engines have a displacement of 1,648 cu.in. and their specific weight ranges from 1.3 to 1.2 per hp. depending upon their power output and equipment.

With regard to the construction of the engine, the Merlin follows conventional vee-type engine practice with a two-piece aluminum alloy crankcase and two monobloc cylinder castings with integral heads set at an angle of 60 deg. The crankshaft is machined from a V.C.M. steel forging and is supported in seven lead-bronze bearings in the upper half of the crankcase. The connecting rods are of the marine type with a plain rod and a forked rod on each throw of the crankshaft. The rods are machined from H-section nickel steel forgings. The aluminum alloy pistons are fitted with three compression rings and two oil scraper rings and have piston pins of the floating type. The four valves in each cylinder head are actuated by an overhead camshaft along each cylinder block. A spur

type reduction gear contained in a housing attached to the front of the crankcase gives the propeller shaft a ratio of 0.477 to 1.

The supercharger is gear-driven by means of a torsionally flexible shaft provided with a damper clutch. The impeller is machined from an aluminum alloy forging and in the case of the Merlin II, its gear ratio is 8.6 to 1. In the two-speed supercharger used on the Merlin X, the change speed mechanism is operated by means of oil pressure from the engine. The carburetor is of Rolls-Royce S.U. design and is of the twin-choke updraft type provided with a single air intake. Both automatic and two-position mixture controls, one incorporated in the carburetor and the throttle barrels and throttle valves are heated by warm oil circulated from the crankcase. Two gear type fuel transfer pumps are provided to supply the carburetor. The automatic boost regulator operates on the aneroid principle and each movement of the pilot's throttle produces a corresponding change in boost pressure. The pressure difference across the supercharger provides the relay force required to perform the actual throttle movements. Ignition is provided by means of two twelve-cylinder magnetos with shielded plugs and wiring.

Lubrication is on the dry sump principle with one pressure-feed and two scavenger pumps of the rotary gear type. A triple relief valve is used to regulate the oil pressure for the variable-pitch propeller (150 lb. per sq.in.), the main bearings (70 lb. per sq.in.) and the lower pressures required for the auxiliaries (4 to 8 lb. per sq.in). Ethylene glycol is used for cooling with a header tank around the upper part of the reduction gear housing. Accessory drives are provided for an electric generator, a tachometer, a low-pressure air compressor, a high-pressure air compressor, an hydraulic pump for the landing gear, an hydraulic pump for the power-operated gun-turret (if any), and a vacuum pump for the automatic pilot and the de-icers. Hand and electric starting equipment of the reduction gear type is specified. The propeller shaft is splined to take Rotol, Hamilton Standard or DeHavilland variable-pitch 3-bladed propellers.

SPECIFICATIONS

Type: twelve-cylinder, ethylene glycol cooled, vee-type, geared-drive, four-cycle
Bore and stroke: 5.40x5.60 in.
Displacement: 1,648 cu.in.
Length and area: 75 in. x 5.8 sq.ft.
Rated output with 87-octane gasoline:
Merlin II: 1,030 hp. at 16,250 ft.
Merlin X: 1,010 hp. at 17,750 ft.
Rated output with 100-octane gasoline:
Merlin RM.2.SM: 1,145 hp. at 16,750 ft.
All rated outputs at 3,000 r.p.m.
Total weight (dry): 1,335 to 1,394 lb.
Specific weight: 1.30 to 1.22 lb./hp.
Fuel consumption: 0.47 lb./hp./hr.
Oil consumption: 0.013 lb./hp./hr.
Compression ratio: 6 : 1.

The Diesel-engined Junkers Ju-86 is a fitting background for Paul H. Wilkinson, who last year visited aircraft engine factories in Germany, France and England, and who is an authority on Diesel aircraft engines. During the First World War Mr. Wilkinson was inspector of aircraft in England with A. V. Roe and the Royal Aircraft Establishment, and in this country has been inspector of aircraft with Boeing Airplane Co. and Douglas Aircraft Co. His description of the Rolls-Royce Merlin engine inaugurates a monthly series which he has arranged to do for AVIATION on foreign flying equipment. Our July issue carried his story of the Guiberson Diesel engine. Mr. Wilkinson is the author of "Diesel Aircraft Engines."

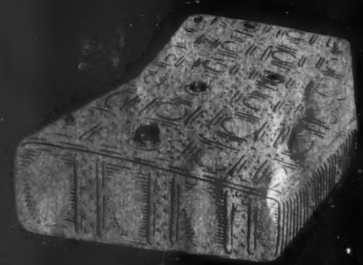
Three factories in England are building Merlins at the present time. These are the original factory at Derby and another at Crewe, and a new $20,000,000 one near Glasgow which by now should be in full operation. All of them are laid out along modern lines and it is probable that from 25,000 to 30,000 men are employed. Inasmuch as production from these factories is insufficient to meet the demand for this type of warplane engine in Great Britain, it appears that the Merlin is somewhat difficult to produce. It might therefore be advisable for us to check up on this point before committing ourselves to a large outlay of funds for production of the Merlin in the United States.

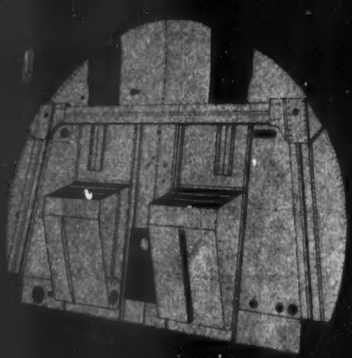
Examination of a British-made Merlin reveals excellent workmanship but it also discloses that considerable modifications to the engine are essential if it is to be adapted to American mass production methods. The rear section and the mounting of the accessories and controls appear to be unduly complicated and the number of hand operations required during assembly appears to be excessive. Standardization of threaded parts and drives and mounts for the accessories will cause considerable delay if some of the engines have to be built to American standards and others to British standards.

According to the latest reports, the Packard Motor Car Co. would require a $30,000,000 expansion program and

(*Continued on page 116*)

GUSTAV GROSSMAN OPERATES
A MODERN PRECISION MACHINE





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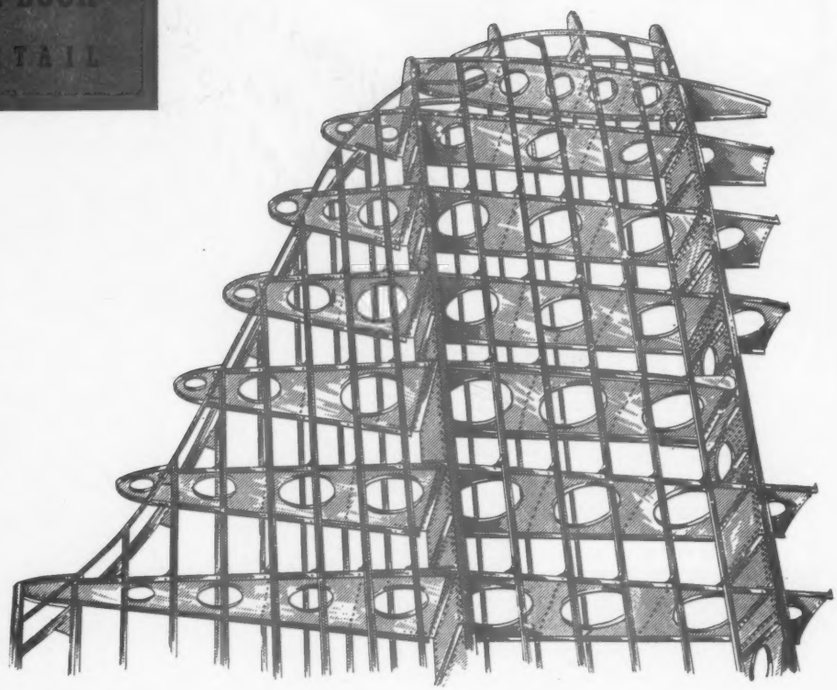
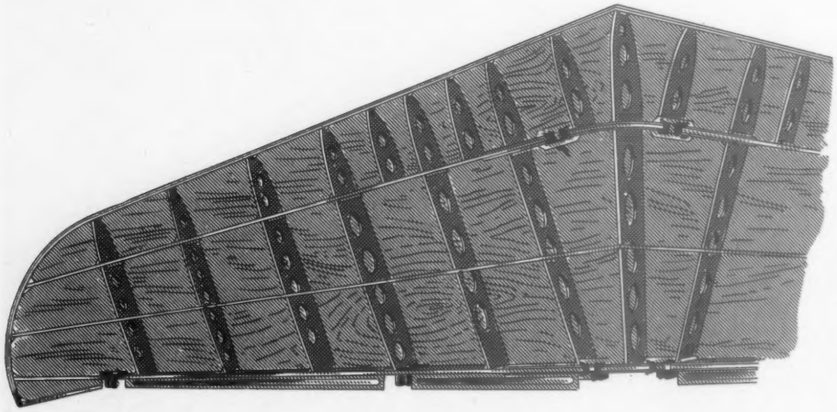
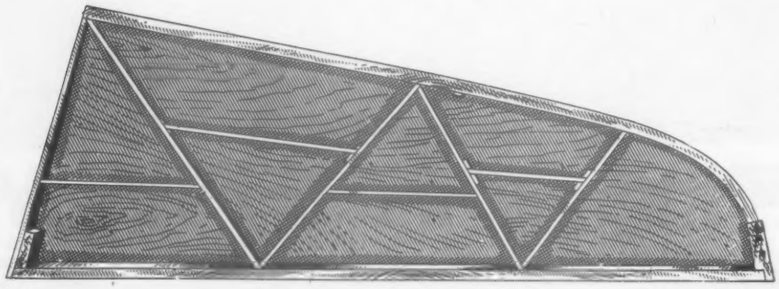


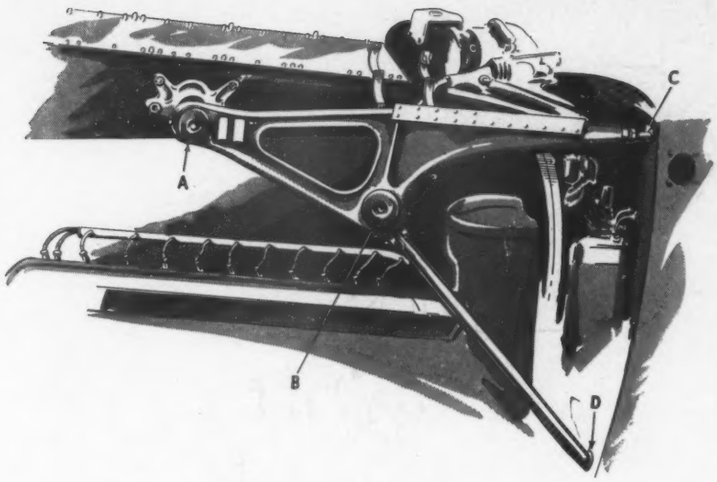
The fin of the Boeing 307 "Stratoliner", right, is made in two sections, the forward portion or "dorsal fin" being a permanent installation on the fuselage. The main fin surface, aft of the first web spar, is a full cantilever structure, attached to the fuselage with steel terminals and taper fins. Below the section drawn, the two main web spars are I-beams and made up of two T-section extrusions riveted to the web, which has riveted-on bulb-angle stiffeners. The ribs are pan-sections, routed out of aluminum alloy and formed on a hydro-press. The vertical stiffeners are standard bulb angles. The fin is covered with .020 AL24-ST, except for the leading edge skin, which is .032 AL24-ST. The whole section is riveted together.



The stabilizer of the Fairchild trainer, designated by the Army as PT-19, left, is a built up wooden structure of spruce spars and ribs covered with three ply mahogany plywood. The plywood is attached to the ribs by means of phenalic resin glue. In tests it has shown that bond made by this glue is stronger along the glue line in shear than is the actual wood itself. The two fittings, one on either side of the center rib on the spar connecting the trailing edges of the former ribs, and also those on the rear spar of the stabilizer are for attaching the unit to the fuselage.

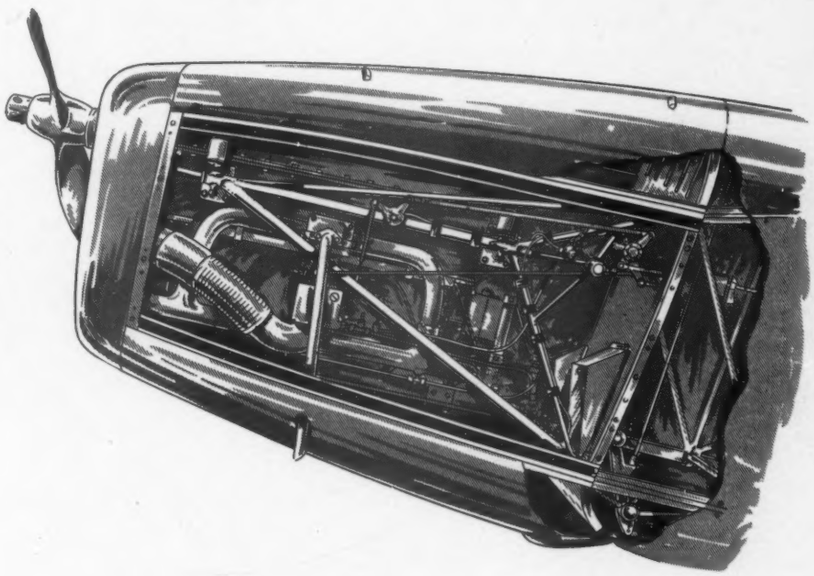


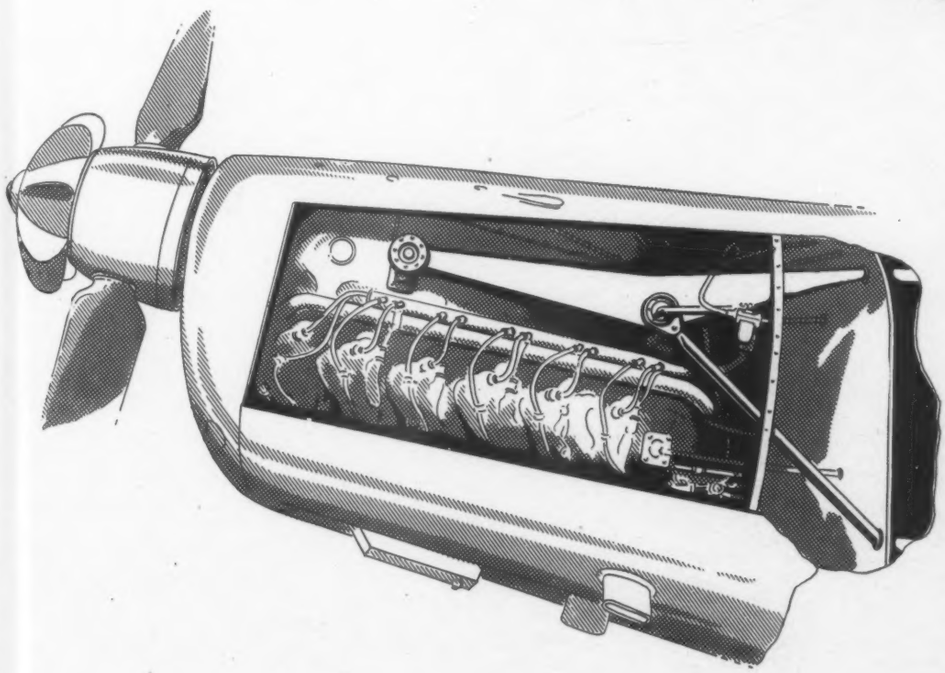
The Johannson lightplane has caused considerable interest as it is also constructed of bonded plywood. The glue used in the construction of the stabilizer shown drawn, as well as the rest of the ship, is conventional casein glue applied with a knife. The "shadows" on either side of the spars is the area where glue is applied.



The engine mount on the Messerschmit Me109 is forged in one piece instead of the welded steel tube construction used in this country. At points A and B connections have been made for the vibration dampening engine mount and these two plus two similar connections on the other side are the main supports for the engine. At point C is located a bolt fitting which attaches the mount to the fire wall. Point D is the other connection to the fire wall for the steel tube at A.

The engine mount of the Fairchild PT-19 right, is of the conventional design used in this country. It is constructed of Chrome molybdenum steel tubing welded together. The mount is attached to the fire wall through five attachment points. When the mount is removed the engine, complete with oil tank, oil cooler, nose cowling and other accessories, is easily removable. The engine is supported by the mount at four points, two on either side of the motor shown in the drawing.





From Germany comes another engine mount similar to the one on the Messerschmitt Me109 shown above. This one is on the Arado Ar96 B a two place training ship similar in size and shape to the Fairchild PT-19. The main section of the mount is made of a forged solid member supporting the engine in two places on each side of the motor. Connections are also made for the vibration dampers. The small blades in front of the propeller are held stationary in flight and are evidently used as a means of increasing the efficiency of the propeller blades. They are sloped at a slight angle so as to give the stream a slight counter-clockwise rotation (when viewed from the front) which would give the propeller blades better performance at the root.

22 Months of CAA

A brief review of progress that was made.

NOW that the Civil Aeronautics Authority has become the Civil Aeronautics Board and a part of the Department of Commerce rather than an independent organization reporting directly to the President, the time is appropriate to review briefly some of the aviation progress made during the 22 month regime of CAA.

The 22 months ending on last July 1 were the most active in the past ten years. All phases of aviation showed great progress. There was steady growth in aircraft, engine and accessory manufacturing, in private flying, and in both scheduled and non-scheduled commercial flying. Credit for this growth cannot be given entirely to CAA, as considerable expansion was inevitable. Wars in several parts of the world and a desire on the part of all countries to re-arm, brought hurry-up orders to our plants building military equipment. Gradual acceptance by the public of air travel would have brought continual improvement to the airlines.

But a critical analysis of the rate of growth in such branches of aviation as private flying and airline travel that had been taking place before August 1938 and the more rapid development after the CAA began to function, leads to the conclusion that CAA deserves some credit for the improvement.

Private flying in mid-summer 1938 was a sick baby. While new pilots were joining the ranks every month, old pilots were dropping out in approximately the same numbers. On July 1 of that year there were 9,352 private pilots and 1,560 solo pilots. Two years later there were 17,362 private pilots, and 9,496 solo pilots. The vast difference is almost entirely a reflection of CAA interest and action concerning private flying. The sick baby has grown into a lusty, noisy youth that has brought a bedlam of activity to airports and to manufacturers of light planes and engines throughout the country.

The story of the Civilian Pilot Training Program and its significance to aviation has been told on several occasions in these pages. During the fiscal year ending last June 30, some 435 college units and 75 non-college units were giving flight instruction. During this summer, the program that ends on September 15 is being given in connection with 496 college units and 300 non-college units. Of the 11,326 private pilot certificates issued during the fiscal year ending last June 30, 7,379 were to C.P.T. students. An additional 300 were carried over by an extension of contract.

In addition to giving flight training to these thousands of young people, the Civilian Pilot Training Program has made three other important contributions. It has benefitted the fixed-base operator, permitting him to buy new airplanes, hire new instructors, learn sounder business methods and draw in additional non-C.P.T.P. business. Activity brings activity, and many airports that were dying a lingering death found that their 20 or 30 college students had such an exuberant time learning to fly that other students were drawn out to the field. While no one got rich, note that no one is dropping out of the program this year.

The second benefit went to the light plane manufacturer, and to all the subcontractors from whom he buys equipment. More than 1,000 airplanes have been sold and the number is going up each month. As an increasing number of students are graduated to advanced training, the builders of this type of ship will also cash in on the civilian program.

The third, and what may prove to be the greatest, benefit is that a reservoir of potential defense pilots is being built up. There are no strings on these youngsters and no obligation to join the military services. Some of them will want to, others will not. And of those who want to become flying cadets in the Army or Navy, not all will be acceptable. But many will, and their civilian instruction will reduce the time required for them to learn military flying.

Airline Development

When CAA assumed control of civil aviation in August, 1938, the airlines of the country breathed a sigh of relief. Under the old Bureau of Air Commerce there had been bickering, backbiting, inefficiency and above all a lack of mutual respect and cooperation. With the coming of a brand new set of administrative officers, the airlines hoped for a better day. That day definitely arrived.

For the first time in years the airlines began to feel they had friends in Washington who were actually trying to encourage air travel. Both the safety record and the balance sheet improved. In the twelve months ending Dec. 31, 1938, the airlines had a net loss from operations of $1,123,-138. In a similar period ending April 31, 1940, the net revenue from operations was $5,429,029. CAA would be first to emphasize that it does not take credit for these gains, but the airlines would be equally quick to insist that CAA cooperation helped to account for better business.

The greatest single boast of the airlines today is not that they are making money, but that they are giving the safest air travel in the world. In approximately eighteen months there has been no passenger or crew fatality. CAA personnel, cooperating in a hundred different ways with the Air Transport Association and with the airlines, added its part to this achievement.

Handling New Applications

The chief criticism leveled against CAA has been for not giving speedier action on grandfather certificates, new route applications and other such requests. But the Authority was a new type of government organization, lead by men who were new in their jobs. They believed that speed alone was no substitute for justice. Before many decisions were made, the entire policy of CAA had to be determined. Once decisions were made, they would set precedents for future action.

As of July 1, 1940, the status of the several applications were as follows:

Grandfather certificates: 104 applied for, 27 closed, 24 approved (on which 59 certificates were issued), 2 denied, 1 withdrawn, 77 still pending, 29 of which are for non-scheduled operations.

New routes: 111 applications filed, of which 16 have been acted on and 95 are still pending. Of the 16 on which decisions have been made, 5 were approved, 1 case was cancelled, 6 withdrawn and 4 denied.

Amendments: 46 applications have been filed for amendments to certificates.

Of the 16 that have been acted on,

(*Turn to page* 116)

ROOSEVELT FIELD

Mineola, Long Island, New York

America's Leading Civil Airport
For Private Flying and Aviation Training

houses facilities for the following complete services:

AIRPLANE OVERHAUL
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INSTRUMENT SALES AND SERVICE
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RADIO SALES AND SERVICE
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AIRPLANE SALES
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RESTAURANT CUISINE
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ROOSEVELT FIELD INC.

is cooperating with the United States Government in its program of expanding the Army Air Corps for National Defense

ROOSEVELT FIELD INC.

owns and operates

ROOSEVELT AVIATION SCHOOL

Accredited by the U. S. Civil Aeronautics Board. Contractors to the U. S. Army Air Corps.
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and suggests to those interested in a career in commercial aviation that they immediately sign and mail the coupon below to Roosevelt Aviation School and get all the facts regarding aviation training.

FALL CLASSES START SEPT. 30, 1940

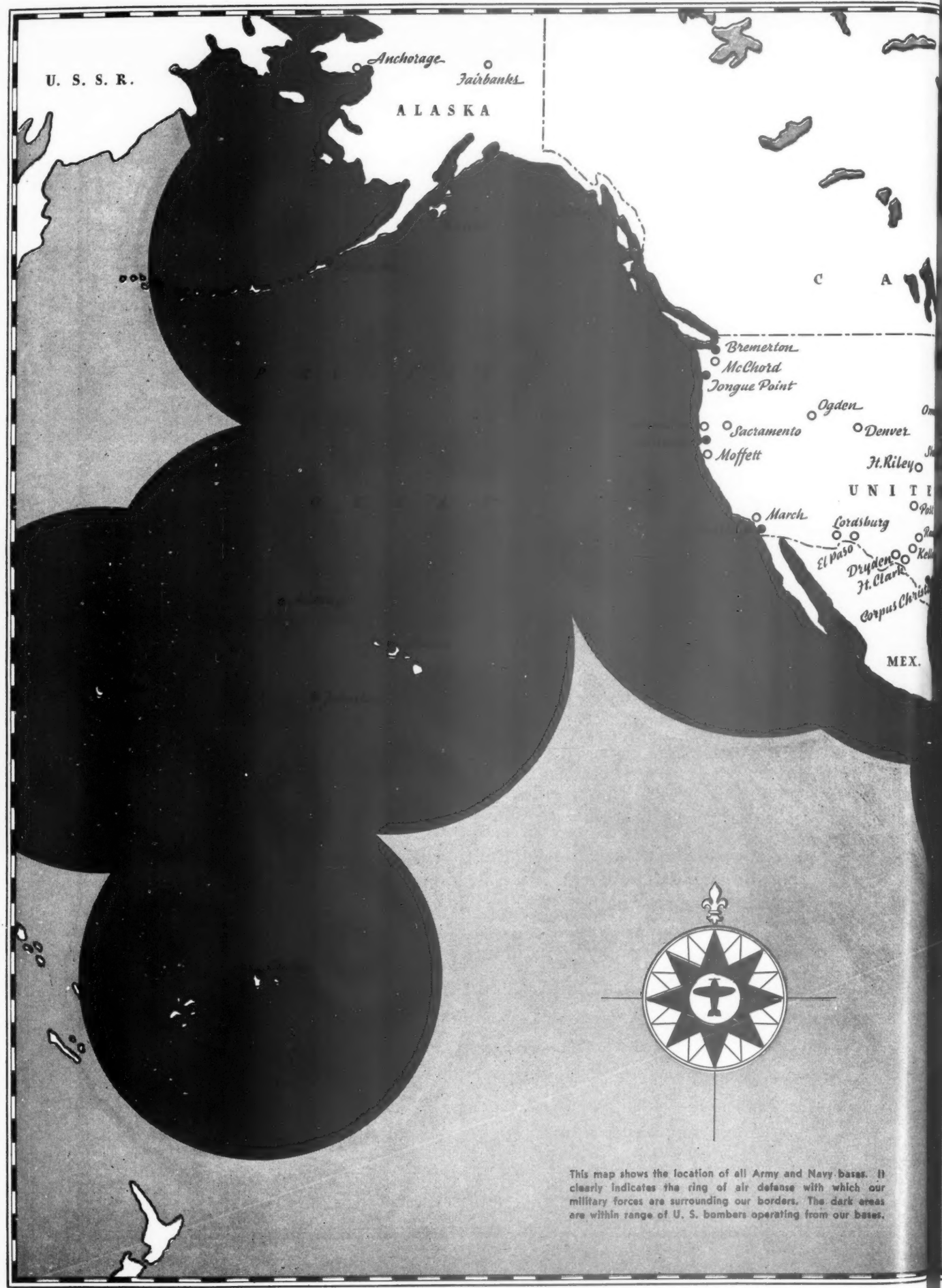
ROOSEVELT AVIATION SCHOOL—at Roosevelt Field, Mineola, Long Island, N. Y.

Without obligating me, send details of course checked:

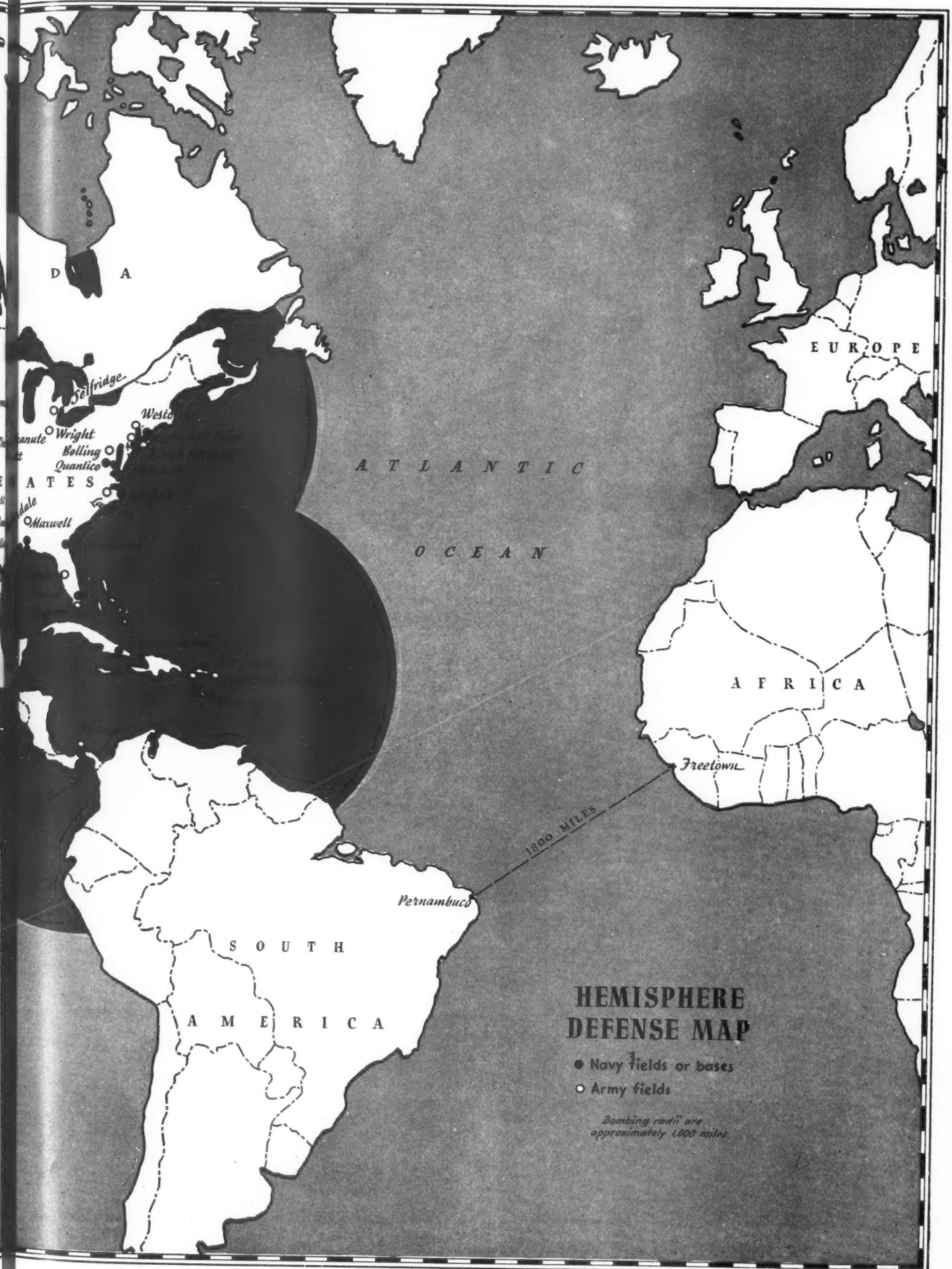
☐ PRIVATE PILOT ☐ COMMERCIAL PILOT ☐ AIRCRAFT SHEET METAL
☐ MASTER AIRPLANE & ENGINE MECHANIC ☐ COMBINATION FLIGHT-MECHANIC

Name..... *Age*.....

Street Address..... *Town*..... *State*.....



This map shows the location of all Army and Navy bases. It clearly indicates the ring of air defense with which our military forces are surrounding our borders. The dark areas are within range of U. S. bombers operating from our bases.


EUROPE
ATLANTIC
OCEAN
AFRICA
Freetown
1800 MILES
Pernambuco
SOUTH
AMERICA
Selfridge
Wright
Bolling
Quantico
Maxwell
HEMISPHERE
DEFENSE MAP
Navy fields or bases
Army fields
Bombing radii are
approximately 1,000 miles

TUBING IS Standard . .

Aluminum tubing in one of the many distribution warehouses.

There is a significant story in tubing made from Alcoa Aluminum Alloys. Through cooperative effort between the forward looking aircraft industry and the producer, it has been possible to set standards of size, shape, and alloy for the tubing used in aircraft structures and "plumbing." The result has been the elimination of much "special" production, costly in both time and money.

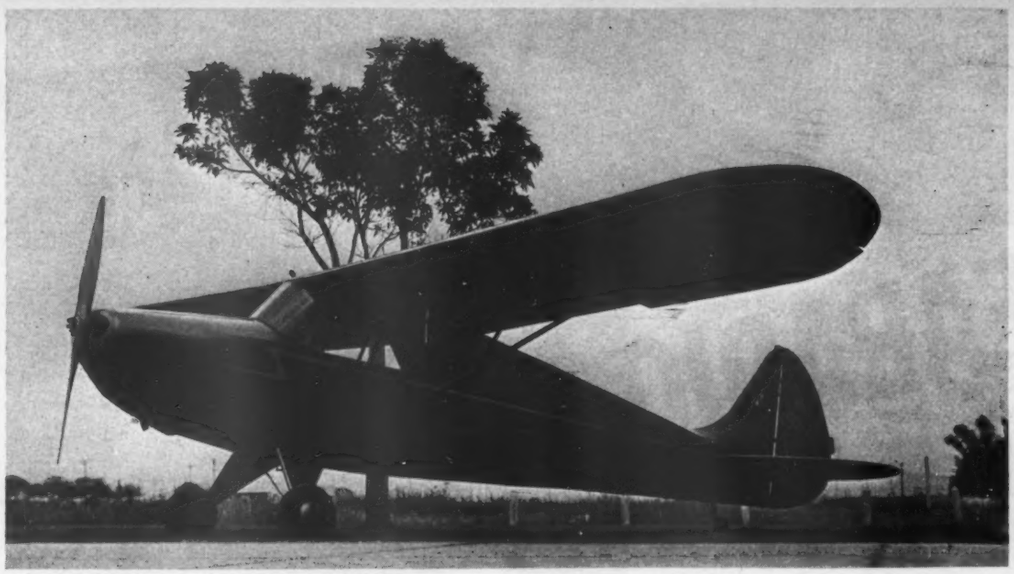
At each bench skilled workers produce the high quality tubing used for aircraft structures and "plumbing."

This story parallels many other similar ones. All demonstrate how the aircraft industry, developing a commercial business in a peaceful America, has prepared its practices and facilities for mass production. "Know-how" has been accumulated against the day when the knowledge and techniques would be required in the fullest application.

In the case of tubing, and in the case of other products made from Alcoa Aluminum Alloys, there has been a conscious effort to keep step with these developments, to produce what the industry needs. ALUMINUM COMPANY OF AMERICA, 2182 Gulf Building, Pittsburgh, Pennsylvania.

Standard tubing made from Alcoa Aluminum Alloys, photographed in a plant where this tubing is made.

ALCOA ALUMINUM



Interstate "CADET"

New two passenger lightplane marks the first manufactured on the west coast

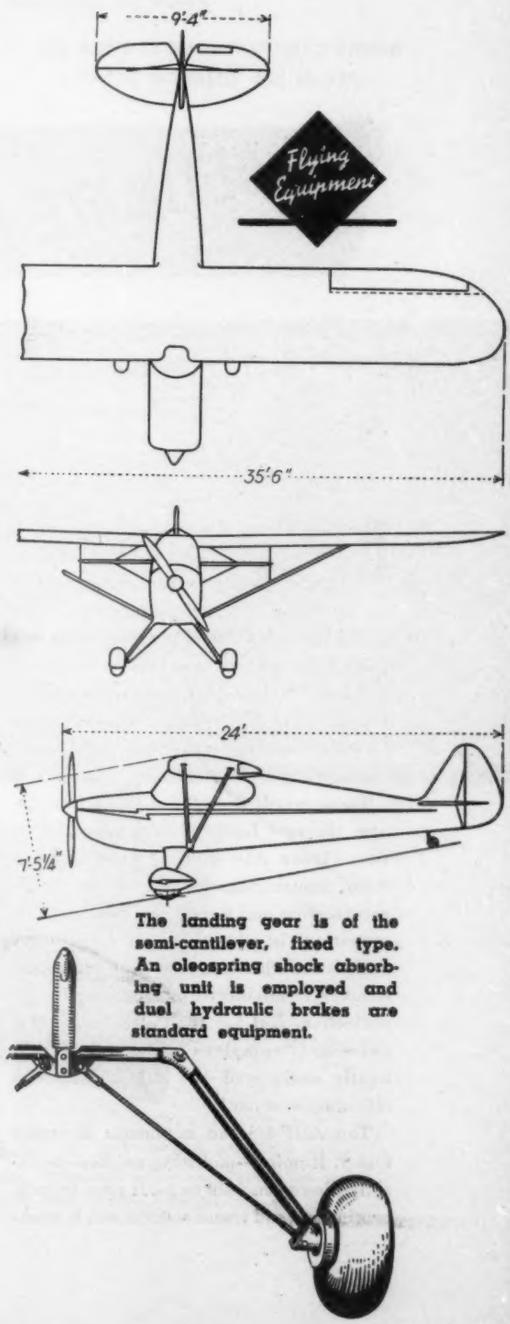
THE Interstate Aircraft & Engineering Corporation, Los Angeles, has launched its low priced "Cadet" sports-trainer lightplane on the market. The new Cadet is of conventional lightplane design and construction with the exception of numerous detailed refinements which recommend it for close study. A high-wing, strut-braced monoplane with conventional landing gear and of mixed construction, the Cadet seats two persons in tandem in the enclosed cockpit and is powered with a Continental 50 or 65 hp. engine. In appearance the Cadet closely resembles other planes in its class, but the performance claimed, 105 mph top or 95 mph cruising on 50 h.p., 114 mph top or 100 mph cruising on 65 h.p. is quite outstanding.

Several advanced design features have been incorporated in the Cadet including a patented fabric spring clip with which all fabric is attached to the wing and other surfaces of the plane. Dual hydraulic brakes are standard equipment. Control surfaces are mounted on ball bearings. The semi-cantilever landing gear is of unusually clean design, with a single oleo-pneumatic shock strut mounted inside the fuselage and linked to both legs of the gear.

Interior appointments include upholstered chairs, suede finished cabin walls and ceiling, carpeted cabin floor, and crackle finished aluminum alloy sheet instrument board on which are mounted the tachometer, altimeter, airspeed indicator, fuel guage, oil temperature and pressure gauges. Cabin heater and carburetor heater controlled from the pilot's cockpit are standard equipment. Steerable tail wheel is also standard. The removable engine mount is carried on rubber-in-shear vibration absorbing bushings.

A production schedule of six hundred planes has been set for the first year of operation. Although Interstate Aircraft & Engineering Corp. has been in operation for several years it has heretofore specialized in the manufacture of hydraulic units and precision parts for various aircraft builders, establishing itself as one of the largest such sub-contracting firms in the country. Don P. Smith, formerly vice-president of the Aviation Manufacturing Corp., and general manager of its subsidiary divi-

(*Turn to page 146*)



The landing gear is of the semi-cantilever, fixed type. An oleospring shock absorbing unit is employed and dual hydraulic brakes are standard equipment.

LEARADIO ADF-8

THE ULTIMATE IN AUTOMATIC DIRECTION FINDERS

ONE DAY, as Robert Louis Stevenson stepped down from a lecture platform, a fluttery young woman swooped down on him and said, "Mr. Stevenson, your books are so delightfully easy to read that I just *know* they were very easy to write!"

Amused by the dubious compliment, Stevenson replied, "Madame, the easier you find my books to read, the harder I found them to write."

Those words describe with perfect aptness the new Learadio Automatic Direction Finder ADF-8. This unique instrument, though rugged in the extreme in its construction and utterly dependable in its operation, is admittedly an exceedingly complex mechanism, requiring an untold number of engineering man-hours for its perfection. But for that very reason—because it *is* complex—because it is brilliantly engineered—the ADF-8 is *incredibly simple to use!*

The ADF-8 is an *automatic* direction finder. It points—and stays pointed—to exactly where you want to go. It gives instant, continuous, and visual orientation. It establishes your position quickly, easily, and clearly. It operates throughout the entire 360° azimuth. It provides automatic unidirectional indication, automatic bi-directional finding, manual visual-null direction finding, and communications reception. All the pilot has to do is switch to the desired function and tune to the proper frequency. The ADF-8 automatically takes care of everything else. Intelligence has been built into it to select the proper circuit conditions for the various bands and functions, to secure and integrate the information, and to represent it graphically for the pilot!

COMPLETE REMOTE CONTROL

The ADF-8 remote control unit provides complete control of all functions and tuning within easy reach of the pilot or co-pilot. By merely glancing at the remarkably clear panel, either member of the crew can determine instantly what function or frequency is in use. A "shutter" exposes to view only one band of frequencies at a time. A six-position selector switch is geared to the shutter and electrically changes the frequency band. A full foot-long tuning dial scale provides extremely accurate resettability, giving 1 KC tuneability on the beacon band, 3 KC on the broadcast bands, and 10 KC on the communication band. When static conditions are so severe that signals cannot be read aurally, this amazingly accurate calibration is positive assurance to the pilot that he is tuned to the proper frequency.

To any pilot, instrument or contact, the Learadio ADF-8 is clearly the best insurance of person and property that money can buy. It is the sober judgment of impartial and expert observers that the ADF-8 represents the soundest engineering, the simplest operation, the maximum accessibility for inspection and service, the greatest adaptability of installation, and the highest usefulness and performance in the whole broad field of automatic direction finders today. Every pilot or executive who is interested in checking these claims, is invited to write for a free booklet fully documenting these statements.

THE AZIMUTH INDICATOR of the ADF-8 gives accurate bearings throughout a 360° scale. It can be mounted anywhere on the panel in a flush, vertical position, and can be read like any other flight instrument. Even when static conditions are such that voice communications and range reception are impossible, the ADF-8 continues to function with reliable bearings.

THE REMOTE CONTROL TUNING UNIT of the ADF-8 is truly a masterpiece of compactness and simplicity. The tuning and function switches automatically select proper radio circuit conditions, insuring against possible operational mistakes. The ADF-8 (as well as the Learadio ADF-7) may be used in conjunction with the new Lear-matic gyromatic navigator, on which full details will be announced next month.

THE ADF-8 IS MANUFACTURED UNDER CAATC NUMBERS 345 TO 350

LEAR AVIA, INC.

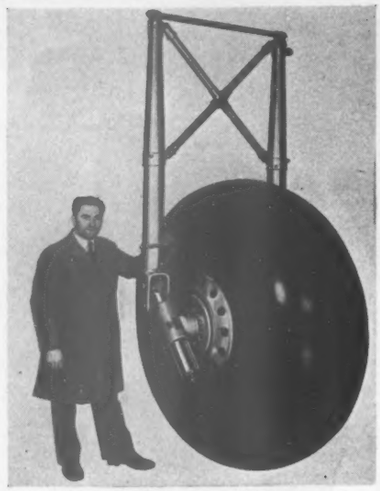
DAYTON, OHIO

Branch Offices: Roosevelt Field, Mineola, L. I., N. Y. • Beech Airport, Wichita, Kansas • Los Angeles Municipal Airport, Inglewood, Cal. • New York Office and Export: 30 Rockefeller Plaza, New York City • Cable Address: Learavia, N. Y.

BUYER'S LOG BOOK

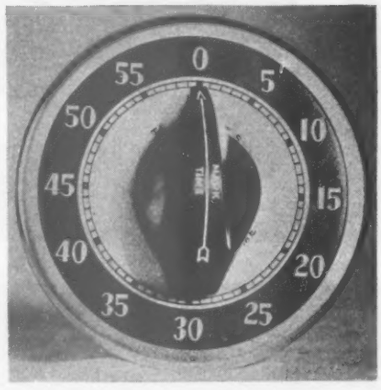
What's New in Accessories, Materials, Supplies, and Equipment

A type of shock absorber known as "levered suspension" has been placed on the market and utilizes a swinging arm which is restained by a suitable springing mechanism, instead of attaching it to the normal vertical telescopic type of strut. The whole springing mechanism lies approximately within the tire radius. The equipment is featured by the Dowty Equipment Co., Inc., Long Island City, New York. The unit has been designed to function with any normal retracting mechanism, and also for the installation of ski equipment.—AVIATION, *August, 1940.*



Dowty landing gear

Many a flight student could profit from carrying an alarm clock in his pocket to remind him what time to come home, thereby retarding the accumulation of gray hairs by his waiting instructor. Such a device has now been provided by the Aeronautical Trading Company, Floyd Bennett Airport, Brooklyn, N. Y. Designated the Aero Time Recorder, this instrument is built to mount on the instrument board, has a diameter of 3 in., and a face similar to that of an ordinary clock, marked off in minutes from 0 to 60, but with a set pointer instead of conventional hands. To operate the Aero Time Recorder the pointer is set by means of a simple twist of the wrist on the integral knob of the pointer, to whatever time period is desired. At the end of that time the pointer returns to zero and a loud bell rings, reminding the pilot that it is time to wake up and land. Or, if the Aero Time Recorder is being used as a navigation aid, it serves to check ground speed along the map course, and can be reset from check point to check point to continue a running check of speed made good.—AVIATION, *August, 1940.*



Aero Time Recorder

A complete new line of aircraft engine starters has been announced by Eclipse Aviation, Bendix, New Jersey, to cover the newer engines of 1000–1500–1800 horsepower. Many advanced features have been incorporated in the interests of reliability and positive starting. The series 41 Eclipse starter is a combination direct cranking electric and inertia starter with integral solenoid engaging device, built for application to engines of 1500 to 1800 h.p. This starter provides all the features of the hand, or combination hand and electric inertia starters, and in addition provides, by means of a heavy duty integral accelerating motor, continuous cranking of the engine after dissipation of the flywheel energy. Available in 6″ and 7″ flange units weighing approximately 53½ and 55 lbs. respectively.—AVIATION, *August, 1940.*

Eclipse starter, Series 41

A midget motor developed especially for aircraft electrical systems is being offered by Eicor, Inc., Chicago. Designated the Model 2310 motor, this new unit is but 2¾ in. long, weighs 1½ lbs. and delivers 1/13 h.p. at 8500 r.p.m. It is designed to give trouble-free service for bandswitching, antenna reels or any type of remote control, and is but one motor in a complete line developed for aircraft use.—AVIATION, *August, 1940.*

One of the difficulties in connection with adoption of the spot welding process by aircraft builders has been that so much of the work could not be taken to the spot welding machines. This problem is solved by the two-gun portable spot welding outfit announced by the Progressive Welder Company, Detroit, Mich. The Progressive welder may be moved from point to point along the production line in a matter of minutes by one operator. The only connections needed are for the power lines, water lines for cooling the welding cables, and air lines for the air-hydraulic pressure booster. A wide range of welding requirements can be covered by the two models of this unit that are offered.—AVIATION, *August, 1940.*

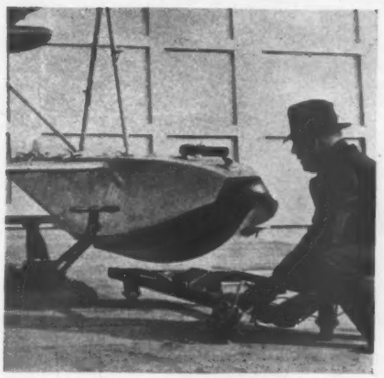
Eicor midget motor

One of the things that has slowed down the seaplane movement among private pilots is the awkwardness of getting the plane in and out of the water. The usual thing has been to install expensive hoist and rail equipment, or to

Two-gun spot welder

build up an equally expensive cart or dolly according to the whims of the individual owner. All this is eliminated by a new set of special seaplane dollies offered at a reasonable price by The Service Caster and Truck Co., Albion, Mich. The Service dollies protect seaplane floats and make it possible for one man to get his plane in and out of the water. A lifting iron is inserted in axle tubes on the pontoons and the plane is raised to the dollies with a small portable hydraulic jack such as is used in garages and service stations. The Service dollies are ruggedly built for heavy service and are designed to fit pontoons without damage to them.—AVIATION, *August, 1940.*

Designed for twisting airplane propeller blade forgings to correct pitch inaccuracies, a new propeller twisting machine is now offered by The Oilgear Company, Milwaukee, Wisconsin. This machine is particularly adapted to work with alloy blades 7" to 14" wide. It permits the blades to be forged very nearly to the finished size so that only a small amount of stock need be removed during the machining operations. It is designed to twist an airplane propeller and maintain the axis of the twist upon the longitudinal centerline of the work piece. It may be adjusted to make twists between various lengths, and will twist in either direction. Control is of simple push-button type with fluid drive to the twisting cylinders.—AVIATION, *August, 1940.*



Service Seaplane Dollies

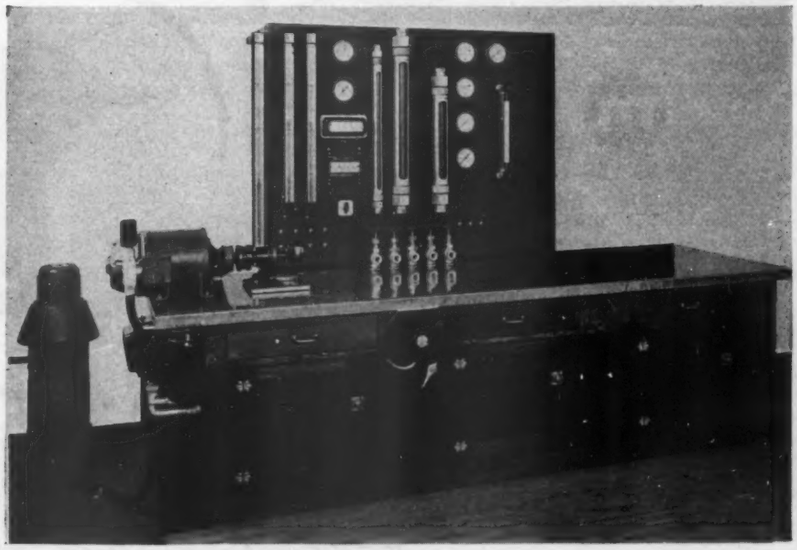
With the current cry for mass production of aircraft there may develop a use in the aviation industry for a unique new machine developed by the Progressive Welder Co., of Detroit, Mich. The device is essentially a hydraulic multi-punch of highly flexible arrangement. As many as sixteen punches may be arranged on a fixture to suit the punch requirements of the piece to be worked. All holes are punched simultaneously by hydraulic pressure.—AVIATION, *August, 1940.*

A master test stand and work bench for conducting complete calibration tests on all Pesco aircraft pumps and accessories, has been announced by Ralph H. McOuat, vice president and general manager of the Pump Engineering Service Corporation, Cleveland, Ohio. Such test equipment is being supplied to the Navy, and to airlines and aircraft maintenance shops. The equipment includes an adjustable speed motor with a speed range from 100 to 4200 rpm, and adapter shafts and couplings for driving all type of pumps and accessories. Accurately calibrated flowmeters, manometers, pressure gauges, vacuum gauges, ammeter, voltmeter, tachometer, and multipoint pyrometer are mounted on the panels for measuring pump capacities, speeds, rates of flow, inlet suctions, discharge pressures, temperatures, etc. Various types of hydraulic cylinders can also be tested, as well as aircraft electrical generators, and constant speed propeller governors.—AVIATION, *August, 1940.*

(*See page 142 for Window-Shopping*)

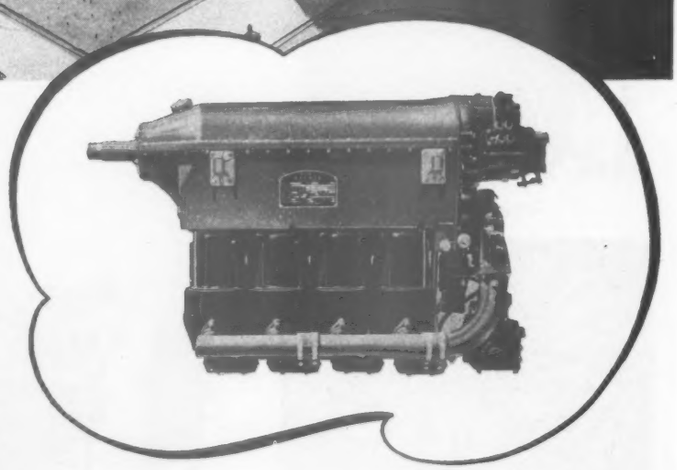
Propeller twister

Hydraulic punch



Pesco Master test stand

IN LINE FOR DEFENSE



As America's largest builder of 125-150 h.p. in-line aircraft engines, Menasco proudly presents its "D" series, the result of a year's research and exhaustive testing. Here, indeed, is the perfected power plant for primary and secondary pilot training.

Illustrated above is the new factory for Menasco's Aircraft Division now building and soon ready for occupancy at Burbank, California.

MENASCO MANUFACTURING COMPANY

6917 McKinley Avenue, Los Angeles, California

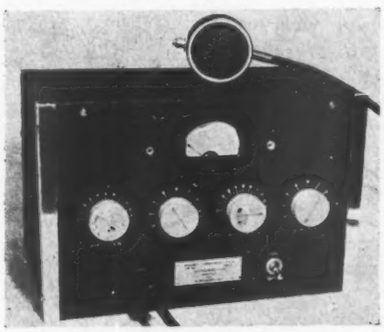
AVIATION

RADIO

Dialing the Air Waves with Don Fink

Emergency Transmitter

A compact low-priced radiotelephone transmitter having 15 watts carrier output at crystal frequency, intended for general portable and emergency use, has recently been announced by Wunderlich Radio, Inc., of South San Francisco, Calif. The



Wunderlich transmitter

transmitter is not specifically designed for aircraft use, but is adaptable to it, and can be supplied in a dural case especially for use in planes. In the standard case, the equipment weighs 17½ lb. and measures approximately 7x7x10 in. The transmitter is intended for operation from a 6-volt storage battery, 2.1 amp. standby and 15 amp. full load. A 6J5 speech amplifier, 6L6 modulator, 6L6 modulated amplifier, and 0Z4 filamentless rectifier are used in the tube line-up. A push-to-talk high level microphone is used. Crystal controlled frequency anywhere in the range from 1,800 to 4,000 kc is available, with other frequency ranges on special order. Operation is also possible on the second harmonic of the crystal frequency, with 10 watts output. The cost of the transmitter, less crystal, tubes, and microphone is $74.50.

F-M in Alaska

Announcement has been made of the purchase of four General Electric frequency-modulation transmitters by the Civil Aeronautics Board, for use as remote control and telephone channel auxiliaries in Alaska. Conventional radio range stations are being set up near Cordova and Juneau, on islands which are not readily accessible. The 250-watt f-m transmitters will be set up on the mainland to control the radio range transmitters, and also to control point-to-point transmitters on the islands. Each frequency modulation transmitter, in addition to the remote control circuits, will contain a telephone circuit, so that weather broadcasts may be relayed to the radio range stations and there rebroadcast to aircraft tuned to the range frequencies. The operators of the entire system will be located on the mainland, although a maintenance man will be located on each of the islands.

New RCA Receivers

Two new aircraft receivers have been announced by the RCA Manufacturing Co. in Camden. Model AVR-20 is a four-tube communications receiver somewhat resembling the AVR-15 radio range receiver. The tuning range is intended for communication only, from 2,300 to 6,500 kc. Two crystal-controlled frequencies in this range are provided, and a beat oscillator is available for CW reception. The front panel contains the tuning dial, a toggle switch for selecting the beat oscillator, a knob switch for selecting variable tuning and the two crystal frequencies, a volume control, and a jack for phones. A Type 991 voltage regulator tube is used to keep the oscillator voltage constant and hence to aid accurate resetability of tuning. The sensitivity is 5 microvolts, the selectivity 23 kc width at 60 db down. The AVR-20 is intended for military command purposes and for plane-to-ground communication in private as well as military ships. It may be powered from the power supply for the AVT-15 transmitter, to which it is a companion equipment.

Model AVR-7H, the latest offspring in the AVR-7 line, is a five-tube superheterodyne tuning the ranges from 195–420 kc, 495–1,400 kc and 2,300 to 6,700 kc. The sensitivity is very high, one microvolt for 6 milliwatts output. The selectivity varies from 7.5 to 8.5 kc off resonance for 60 db attenuation. The power drain is 2.1 amp. at 12 volts. The receiver is fully remotely controlled and contains vibrator power supply and beat oscillator.

New Battery System

New equipment for reception, direction finding and transmission, all battery operated, has recently been put into production by Lear Avia, Roosevelt Field. The receiver, Model AMR-1, is a five-tube superheterodyne containing an r-f amplifier, combined first detector and oscillator, intermediate amplifier, combined second detector and first audio and beam power output tube, all filament type tubes in the 1.4-volt series. The power supply is 90 volts of B battery at 11 ma, and 4½ volts of A battery at 300

New RCA receiver Model AVR-20

ma. The sensitivity is 2 microvolts for 50 milliwatts output at a signal to noise ratio of 4-to-1, and the selectivity is adequate to give 3 kc separation between stations. The tuning covers the beacon band from 200 to 500 kc. The total weight including batteries, cables, and headphones is just under 12 lb. The receiver is also available with equipment for direction finding, under the designation AMRL-1. The additional equipment includes an r-f loop transformer, loop cable, switch and the shielded loop. While this equipment can be added to the AMR-1 receiver, the equipment must be returned to the factory for this purpose. Battery life is about 150 hours. A newer model of the receiver, Type AMR-12 (AMRL-12 with the loop), uses the same tube line-up and has essentially the same electrical and mechanical specifications, but is intended for operation from a dynamotor power supply.

The AMT-1 transmitter is a five-tube unit, also completely dry-battery operated. It employs five 1Q5GT tubes one as crystal oscillator, a pair as audio modulators, and a pair as modulated power amplifiers. The unit operates in the range from 2,700 to 6,300 kc, with telephony modulation over the audio range from 250 2,500 cps. The battery life is approximately 100 hours.

The power output, while low, is sufficient to give a range of 20 miles or more with a hand reel trailing antenna. The entire transmitting equipment, including power supply, microphone and holder, cable and fixed trailing antenna weighs 11 lb., 14 oz. The weight of the complete two-way combination is 20 lb. 7 oz.

Another transmitter similar in general specifications, but having considerably greater power output is the AMT-12. This transmitter is intended for operation from the AMG-12 dynamotor power supply, employs five 6V6GT tubes, and develops 10 watts carrier power. The input power, including receiver and transmitter at standby position, is 4.5 amps at 12 volts. When transmitting the current increases to 8.0 amps. The weight of the AMT-12 equipment complete with power supply, antenna lead and microphone is 6 lb., 3.5 oz. The AMRL-12 receiver (equipped for direction finding) and the AMT-12 transmitter have been priced as a unit at $377.

C.A.B. Checked Ranges

For periodic checking of the radio range beacon stations throughout the United States and Alaska, the C.A.B. has recently purchased 84 impedance-measuring units constructed by the Washington Institute of Technology according to specifications of the Radio Development Section. Measuring of radiator and transmission line impedances are made every three months to keep the range courses within the 1.5 deg. tolerance specified by the C.A.B. regulations. Two of the impedance units are to be used in conjunction with the installation of two new radio range beacons in Alaska. The units are portable, weigh 34 lb., and measure 10x20x12 in.

Impedance measuring units

New Lear battery operated system

New Literature

A recent publication should be of interest to the aircraft radio fraternity. It is a publication of the C.A.B. entitled "The Use of the Airway Radio Range and Other Radio Aids," a booklet of some 41 pages which states in simple terms the pertinent facts concerning radio range practice. The book is intended primarily for owners of private aircraft equipped with radio, and serves the purpose of "a non-technical presentation of enough elementary theory to prepare any pilot for practical flight training in the use of radio aids". The author (who is anonymous) has done an excellent job. Fourteen diagrams illustrate the construction of ranges, field patterns, and procedures followed in various flight problems.

10-channel Radiotelephone

An elaborate radio telephone transmitter-receiver combination intended for use by airlines and large private planes has recently been put on the market by Western Electric. The transmitter, Type 27A, has a maximum power output of 125 watts, on ten pre-tuned frequencies in the range from 2,000 to 15,000 kc. The weight is slightly over 60 lb., the dimensions approximately 17x17x12 in. Modulation is possible with CW, MCW, phone or facsimile. The receiver, Model 29A, covers the same tuning range, provides 300 milliwatts output in the audio channel, and weighs 18.3 lb. The transmitter and receiver are controlled simultaneously from a small switching panel mounted on the plane's instrument board. Electrical bandswitching, controlled by a knob on this panel, gives the operator control of any of the ten pre-tuned frequencies. Another dial selects the type of modulation. Individual condenser combinations for matching the transmitter output to various types of antennas and transmission lines are also provided.

NEW SPEED IN PRINTING

This Bruning Mercury "75" Continuous BW Printer has a much greater speed range than printers costing much more—0 to 25 feet per minute. It utilizes the new Hanovia Mercury Vapor Quartz Lamp to provide high speed printing and uniform light distribution at a fraction of the cost of carbon arc machines of equal capacity.

NEW SPEED IN DEVELOPING

This Bruning Model 154 BW Developing Machine is designed for use with the Model "75" Printer. Tests prove that with the Model 154, one man can develop 1200 8½x11 BW Prints per hour, and that two men can develop 2600 8½ x 11 BW Prints per hour.

NEW WINGS For Your Production!

SPEED—and more speed! That's what today's fast pace demands in aircraft production.

And speed is the reason why Bruning Black and White Prints are displacing blue prints in the aircraft and allied industries.

Where blue prints require FIVE separate operations, Bruning Black and White Prints require only TWO: exposure and development. BW Prints need only a matter of seconds for exposure . . . the same for developing . . . and the print is then ready for use, without washing or drying!

What's more, BW Prints make possible the quantity production of prints in the exact size of your tracings—through the use of BW sheets cut to size. There is no time lost in trimming prints—and no trimming waste.

In the plant, BW Prints save time because their sharp black lines are easier to read . . . easier to check. And many a manufacturer has found that Bruning BW Prints, because of their special production advantages, actually cost less than blue prints!

A new, FREE book, "New Light on Prints" tells the whole story of the BW Direct Printing Process . . . shows exactly how BW Prints speed production while saving money for their users. Send today for your free copy!

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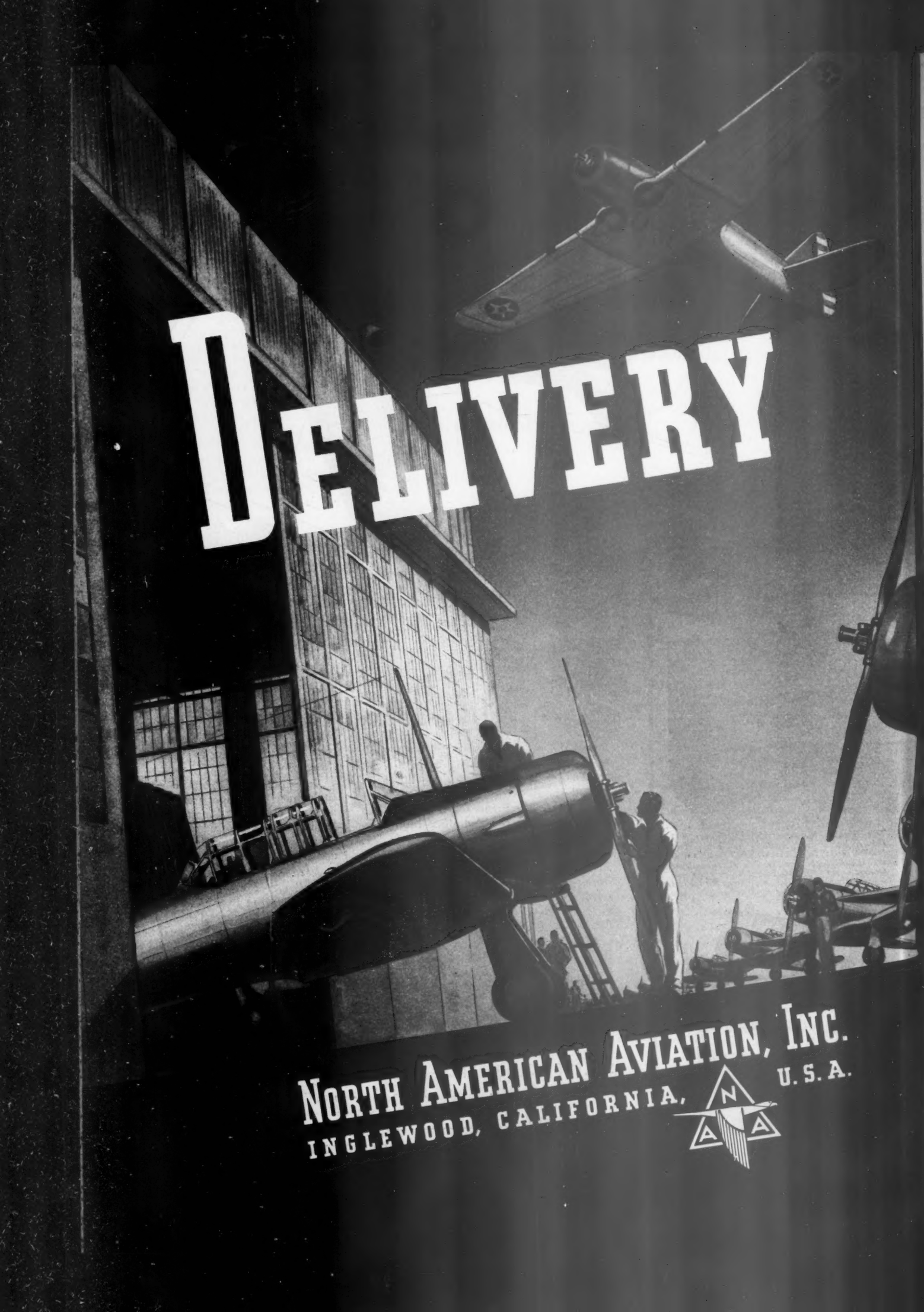

DELIVERY
NORTH AMERICAN AVIATION, INC.
INGLEWOOD, CALIFORNIA, U.S.A.

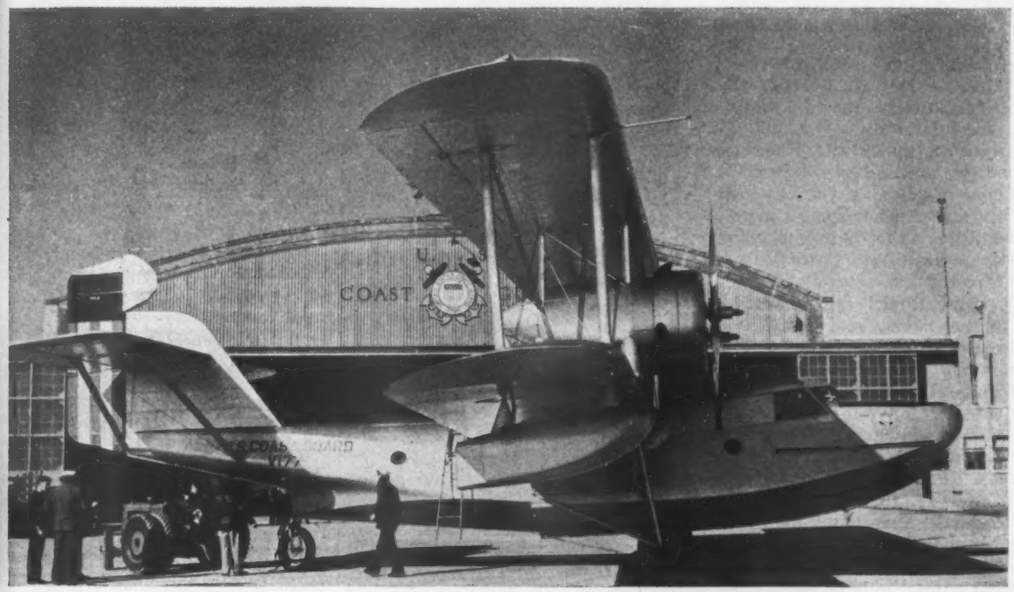
THE AVIATION NEWS

REVIEW, COMMENT, FORECAST

BLAINE STUBBLEFIELD
Washington
C. F. McReynolds, Pacific Coast
Jay P. AuWerter, New York
E. R. Lockin, New York

AUGUST 1940

Coast Guard Celebrates Anniversary



Rudy Arnold

ABOVE is a U. S. Coast Guard Hall PH-3 long range flying boat, symbol of activity in the Coast Guard. This month the Coast Guard is celebrating its 150th anniversary and is commemorating a long and honorable history.

Founded in 1790, the organization has had a continuous existence performing a wide variety of worthwhile services. The aviation branch originated in 1920 when six surplus war planes were borrowed from the Navy. Flight personnel was trained at Pensacola, and the first base was located at Morehead City, N. C. In 1926 bases were built at Ten Pound Island, Mass. and at Cape May, N. J. Today there are about a dozen air stations dotting our coasts.

Various types of airplanes are in use, including both seaplanes and land planes. Seaplanes in service include the Hall, two types of Grummans, and the Douglas Dolphin. Stinsons and Fairchilds are most commonly-used land planes.

In case of national emergency, the Coast Guard becomes part of the Navy. Because of about 20 years of experience, flying in all kinds of weather and under all conditions, the Coast Guard is a great national asset.

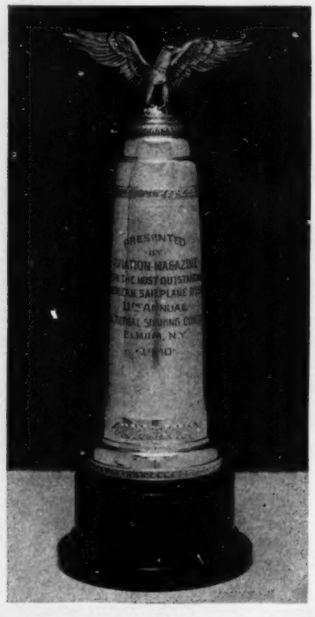
British Press Combine

BELOW is an English bombardier practising with a British bombsight made by Barr & Stroud. Because of the strict censorship prevailing, detailed news of the great accuracy of British bombing has not come through to the public, but service men returning from abroad report that British bombers are doing effective work. Reports have it that many German residents along the Ruhr regularly climb out of their beds at 12:30 AM and pile into their bomb-shelters, because, almost like clockwork, the British bombers come over at 1 AM. If the accuracy is as good as is claimed an insomnia pill salesman could do a land office business.

NATIONAL AVIATION

Sailplane Design Award

A sailplane designed and built by the Aero Industries Technical Institute won AVIATION magazine's silver trophy at Elmira for the best technical design contributed to gliding in 1940. Judges appointed by the Soaring Society of America based their award both on the engineering and performance of the Aero I.T.I. sailplane.



The winner is known as the G-2. It has a metal monocoque fuselage with a monospar wood constructed wing. Its outstanding performance was a flight of 113 miles to Lewistown, Penna. The new ship proved to be remarkably fast, as it covered the distance in a little over two hours. A feature of the design is the trailing wing flap which controls the lift of the airfoil section.

Other ships competing in the design contest were the Briegleb BG-7, the Midwest combination utility and sailplane model which has two sets of wings, and the Lawrence Tech mid-wing high performance sailplane. The award was made by Lieut. Robert M. Stanley, last year's winner.

Soaring Records Set

Two American distance records were set at the Elmira contest of the Elmira Area Soaring Corp. last month. John Robinson flew a Ross-Stephens Sailplane 290 miles for the record and first place in the contest. Robert Stanley set a new two-place record at 216 miles in a Schweizer. Taking a Wolf up 4,183 ft. Helen Montgomery set a new women's altitude record.

Thirty gliders and 72 pilots participated in the two-week contest, running up a total official flight mileage of 3,166.

How New CAA Works

Washington (AVIATION BUREAU)—On July 1 the new Civil Aeronautics Board, and the Administrator of Civil Aeronautics, under the Department of Commerce, started to function in place of the Civil Aeronautics Authority. You can still call it the Authority when speaking of the two offices combined.

The Board will continue to make rates, and issue certificates of c & n. It will prescribe safety standards, rules, regulations. It will share with the Administrator the issue, suspension and revocation of safety certificates. Under the wing of the Board is the Bureau of Safety, replacing the Air Safety Board. The chief of this bureau will investigate accidents and recommend preventive measures, but he cannot act independently in the face of CAB and other government agencies, as the old Safety Board could. Jerome Lederer, an able air insurance engineer, is chief of the Safety Bureau. But CAB itself is the high priest of safety.

The five-man CAB is composed of the same people as before, except Chairman Hinckley, who is the new Assistant Secretary of Commerce, and Dr. Geo. B. Baker, professor of Commerce and Transportation at Yale, who has been newly appointed. FDR has designated Harllee Branch as new chairman, with E. P. Warner, as assistant.

The CAB appears to be completely independent of Commerce; it has its own budget, independent of both Commerce and the Administrator; the President cannot dismiss the members except for malfeasance.

The Administrator is, as before, the custodian of the government's airway properties. He takes over many former functions of the old Authority; has substantial jurisdiction over enforcement of safety provisions; shares substantially with CAB in the creation of safety standards. CAB's attorneys have not yet clarified the overlapping of authority, at least not for publication. In addition, the Administrator is now responsible for the entire civil pilot training program.

Col. Donald H. Conolly, of the Army Engineers, has been chosen by FDR for the job. Col. Conolly's experience in aviation has been mainly in connection with WPA airports. The Administrator will report to Mr. Hinckley, who, as Assistant Secretary of Commerce, is the real administrative authority. Clinton Hester, former Administrator, has gone into private law practice after many years as a successful career man in Washington.

Critics of the reorganization of CAA are still resentful. They see broad inconsistencies in the President's written praise of an organization which he was at the moment abolishing for reasons variously stated by proponents. Opponents of reorganization in Congress are already preparing to attack the new set-up. Opinion now is that they can't hope for success until war excitement ends.

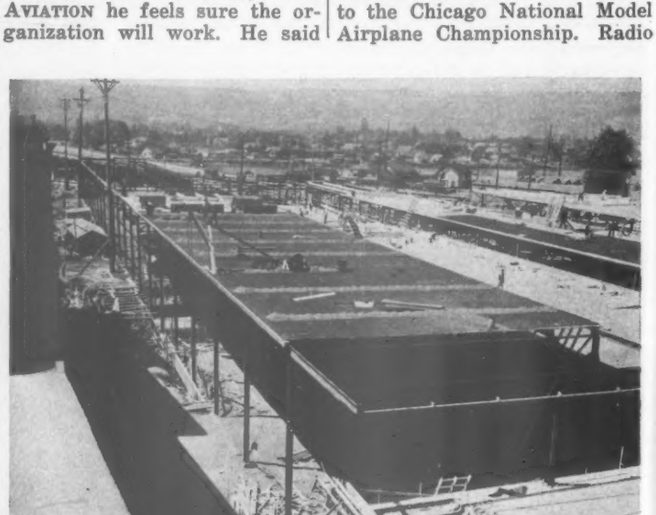
Meanwhile even some opposition agrees that any published criticism now would accomplish nothing. Mr. Hinckley told AVIATION he feels sure the organization will work. He said the law as it stood was unworkable. He said confidence must be placed in the ability and sincere intentions of the executives and personnel of the Authority.

I. Ae. S Kollsman Library

Establishment of the Paul Kollsman Library has been announced by Major Lester D. Gardner, executive vice president of the Institute of the Aeronautical Sciences. Major Gardner, making the announcement to the second annual summer meeting of the Institute at Pasadena, Calif., revealed the endowment of the library through a $50,000 gift from Paul Kollsman of New York and the Square D Company of Detroit. This gift will make available more than 2,000 aeronautical books and about 100,000 books on general engineering, which will be loaned by mail to engineers and aviation people throughout the United States.

2,000,000 Air Youths

Youngsters' aviation groups under the aegis of Air Youth of America, chairmaned by Winthrop Rockefeller, now total near two million, says Ernest Gamache, executive director. More than 1,200 boys and girls traveled at their own expense to the Chicago National Model Airplane Championship. Radio



SOME 15 ACRES of factory expansion is now going on at the Boeing factory in Seattle. New addition costs over $2,000,000, totals over 600,000 square feet. Austin Co. is builder.

SUCCEEDING Mac Short as president of Vega Airplane Co. is Courtlandt S. Gross, since 1933 sales executive at Lockheed Aircraft's New York offices. This change in set-up enables Short, in his new job as vice president in charge of engineering, to devote all his time to engineering problems on military types.

controlled models made long-range flights which attracted the attention of the Army and the industry. Numbers of the more expert of the young "aviators" are being hired by manufacturers, and by aviation branches of Army and Navy. A large group of them is working at NACA's Langley Field, Virginia. Air Youth is now only a service organization; it does not accept members. But a program of training for leaders and teachers for the aviation groups is being worked out, and this fall Air Youth will try to put a junior aviation club in every secondary school in the country. Air Youth of America's address is 30 Rockefeller Plaza, New York.

CANADIAN AVIATION NEWS

By James Montagnes

With fast changing conditions in Europe, Canada has been forced to develop the British Empire Commonwealth Air Training scheme without help from Great Britain. Originally Great Britain was to supply airplane engines and some planes for the training plan, but now engines are being imported from the United States and airplanes are being built in Canada. It was officially announced at the beginning of July that 200 elementary training planes had already been delivered by Canadian plants, that by the end of 1940 all the elementary training planes needed for the plan would have been produced by Canadian plants, and that one company was turning out more than two planes a day. Such great strides have been made by the Canadian aircraft industry that the larger part of the original program which covered two years has been compressed into a one year plan, according to Transport and Munitions Minister C. D. Howe at Ottawa.

Meetings were held in western Canada during the latter part of June and early part of July by the Board of Transport Commissioners, appointed by the Canadian government to look into unnecessary duplication of air services in northern Canada. The board heard transport operators flying into the North West Territories, on the minimum service necessary to cover that territory. The survey was made so "that appropriate steps could be taken to prevent such unnecessary duplication of service to the end that economies may be effected and the personnel and equipment released from such services to help meet the present national emergency," the Board stated.

Meanwhile the 1939 report of Mackenzie Air Services Ltd., Edmonton, one of the large operators into the North West Territories, showed that the war reduced traffic last year with only 2,361 passengers being carried as against 4,125 in 1938, freight and mail being down from 826,000 lb. to 662,200 lb. The company sold four Noorduyn Norseman aircraft from its fleet to the Royal Canadian Air Force in 1939, for the sum of $95,475.

Two planes of Canadian Airways Ltd., were used in June to fly the annual Indian treaty money to northern Ontario Indians. Piloted by Art Schade and Rod Grattan, the Junkers and Fairchild planes carried the Indian treaty paying party and doctor into the bush of northern Ontario, at a season when the black bush flies were at their worst. It was a three week trip, previous it was 3 months.

We are sorry to announce the death, on July 25th, of Mrs. Earl N. Findley, wife of the editor and publisher of U. S. Air Services. A resident of Washington since 1917, she was acquainted with many aviation leaders through her active interest in her husband's participation in aviation activities, beginning with the first aviation meet at Belmont Park, N. Y., in 1910.

THE WASHINGTON WINDSOCK

by BLAINE STUBBLEFIELD

Hemisphere defense goes forward in the shape of huge Pan American airport construction south of the border. Plans to use part of FDR's "blank check" money that way broke in Washington papers, which roused ire of officials who called the story a breach of the public interest. Establishment of air defenses can be accomplished through PAA much easier than via the diplomatic route.

You've heard before about the part the air transport system may play in war mobilization. You'll hear plenty more. Some CAA and war officials believe airline expansion should stop, now, so the Army can have the money, ships, pilots—might even advocate trimming the system to a skeleton of trunk lines in wartime. Others believe pilots and ships at work in mobilization commerce will serve better than if in military service. Odds seem to be on the latter philosophy to win.

Northrop sold 24 light bombers to Norway before the blitz, and is still going ahead with delivery. No, Hitler isn't getting them. The real government of Norway went to England, with the King, who took all the gold with him. So Britain gets the Northrops. She also got the Norwegian airforce and most of the naval and merchant shipping.

The Academy of Model Aeronautics was formed at the Chicago Model Championship Meet, July 1–6. It is now affiliated with National Aeronautic Association. AMA will have charge of all official model activity, sanctioning meets under NAA license, will be custodian of all model records. Over 150,000 model builders are enrolled in various clubs of AMA, 12,000 expert contestants, and 500 contest leaders.

CAA denied Eastern Airlines' application to continue its giro mail service between Philadelphia Postoffice and airport, but recommended company ask for a "temporary" certificate. CAA found after hearings that the giro mail cost $3.62 a mile or 70 cents a pound for a 6-mile run, and that this cost is not justified economically. But the temporary certificate can be granted under the "aviation promotion" clauses of the law. CAA and the Army certainly will further develop the art of flying and building rotary wing aircraft. It costs money; any mail carried in the bargain is all velvet.

The reason why Germany shows loggy performance in the air is poor gasoline. British analyzed fuel in downed planes, found octane 73 to 85, the ordinary automobile range. Supposition: they used up high test in the Battle of France.

Anything can happen now in foreign air transport, because it's increasingly vital to international relations. Pan American's rapid expansion in South America will be supplemented by even more decisive steps there. American Export probably will apply for other routes in time. Still other operators may soon muscle in on South America, the Pacific, and even Alaska. Pan American itself might move to enter the United States from the south at Washington or New York.

Willkie may win air transport in a walk—except 2 or 3 lines. Patterson's blast at CAA in Denver (and dinner with Willkie) was the opening salvo. Republican campaigners will throw the CAA re-organization into the New Deal's teeth, plus the FDR-Farley air mail cancellation, plus failure to expand air services. Private flyers, still irked by air regulations, also easy Republican picking.

N.A.A. Denver Congress

Delegates to the Denver Air Congress left the three day meeting on July 10 with the conviction that a new spirit was ruling N.A.A. Some 400 delegates and guests attended the meetings, which were run as a real discussion forum with no set speeches except during the banquets.

N.A.A. officials were highly gratified that such important aviation figures as President W. A. Patterson of United Air Lines and Robert H. Hinckley, new Assistant Secretary of Commerce, should have used the congress as a medium for presenting their views. In a fiery speech, President Patterson criticised C.A.A. for inefficiency and delays. On the last night of the meetings, Mr. Hinckley strongly defended C.A.A. and handled a tense situation with considerable tact.

Other high lights of the meetings were two speeches broadcast from Washington especially to N.A.A. delegates by Gen. George C. Marshall and by Admiral Harold R. Stark. These talks tied in well with the national defense theme which prevailed throughout the meetings. Delegates from all parts of the United States dedicated their local chapters to one purpose: usefulness to U. S. aviation.

S.A.E. Banner Year

The Southern California Section of the Society of Automotive Engineers has just completed a record 1939-40 year so far as its aviation activities are concerned. Under the chairmanship of Ellis W. Templin, the society has held a record number of aviation meetings, attracted record crowds throughout the program of meetings, and has signed up a record volume of new members from among the aircraft engineers of Southern California.

No Federal Plants Yet

Washington (AVIATION BUREAU): Former Ass't. Secretary of War Johnson's statement that the government doesn't plan to build aircraft plants is taken here to mean that private industry will be given a reasonable chance to do the job—not that government plants have been definitely ruled out. Prime immediate aim, of course, was to get a horde of Chamber of Commerce executives, all demanding plants for their towns, off the necks of the Army and Defense Commission.

Straight federal financing of plant is likely to come back into the picture if the machinery to finance expansion now being set up breaks down, if expansion doesn't go fast enough to suit the Defense Commission, or if the Administration decides really to go ahead on its frequently proclaimed objective of de-centralizing the industry; officials admit that if a private manufacturer builds a plant they can't tell him where to put it.

Airport Legislation

The airport expansion program is expected to receive further consideration by Congress when the Senate Commerce Committee reopens hearings on a revised draft of the McCarran bill.

The new bill would continue the present system of using WPA labor and funds, under supervision of the CAA Administrator who would be provided $25,000,000 to administer the program and supplement WPA allotments for airport projects. Although no more than 2 percent of the total appropriation could be spent on any one airport, the Administrator could pay as much as 75 percent of the total cost, or add enough extra to WPA's contribution to bring federal participation up to 90 percent. These limitations, however, would not apply to projects certified by War or Navy as vital to defense.

Also, the new bill allows localities to deal directly with CAA rather than, as in the first bill, through a state aviation agency.

Meanwhile, CAA announced an increase since January first by 204 to 2,655 in the total number of airports, landing fields and seaplane bases in the U. S.

Warning Demanded On High Structures

Before you can put up a flagpole down by the airport you've got to tell the CAA about it. Acting under newly granted authority, CAA now requires that it be notified when any structure is erected within 3 miles of an airfield to a height greater than a fiftieth of the distance from the field. The authority has no power to do anything about the structure, but it wants to know where it is—so it can tell pilots—and will take you for $500 if you don't comply. A letter to CAA in Washington telling when, where, and how high is all that is needed. The new rule only applies if the airfield is within 10 miles of a civil airway and either is equipped for night operation or has a building and a 2,000-ft. runway.

DEFENSE

Two Billions for 19,000 Planes
Army Gets 15,000; Navy Gets 4,000

Washington (AVIATION BUREAU)—The largest single appropriation for aircraft in the country's history — over two billion dollars—was thrown into the legislative machinery as Congress returned from recess confident that overwhelming popular approval would support almost unanimous action on the President's request to build up the combat air forces to 25,000 planes.

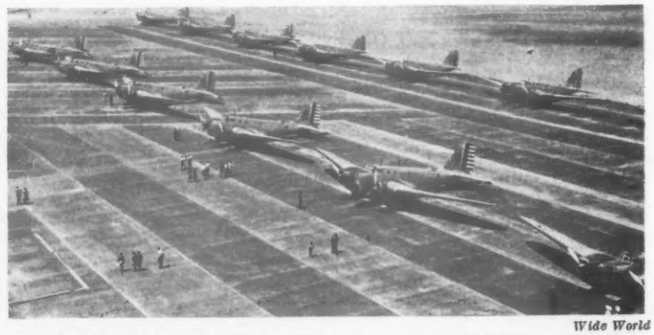
Almost one-half, or $2,023,402,304, of the latest request of $4,848,171,957 for additional national defense supplies is earmarked for 19,000 new airplanes, complete with spare parts, modern equipment and accessories. The Army will get 15,000 of these planes, the Navy the remaining 4,000.

A great part of the appropriation, however, is represented by contractual authority extended to the Army and Navy rather than by direct cash outlay. Thus, the Air Corps is allotted $520,802,304 in cash, plus $1,002,600,000 in contract authority, the Navy's Bureau of Aeronautics $125,000,000 and $375,000,000 contract authority.

Another $325,000,000, half in cash and half in contract authority is set aside for the Army for use in expediting production for national defense. With this sum, the Army may purchase equipment or supplies, erect plants, acquire land, furnish government-owned facilities to private plants, train civilian employees, or do anything else to speed up the defense program which the National Defense Commission or the President may consider necessary.

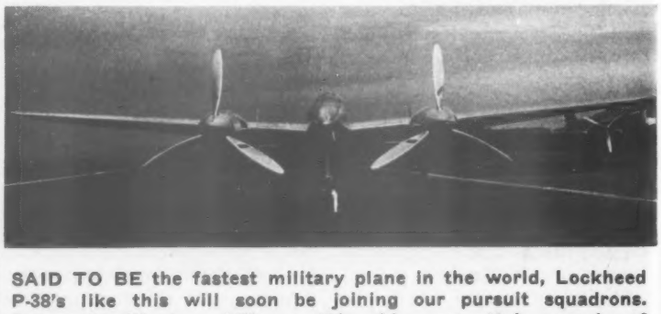
In addition, the bill provides large sums to continue air base development and begin construction under the latest Naval expansion bill—the third of the session — which increases the surface fleet by 70 percent (including a total of twenty aircraft carriers) and raises the Naval air force from 10,000 to 15,000 planes. The President may even go above this total should an emergency arise.

This is the same Congress which only five months ago re-



Wide World

OPENING DAY at McChord Field, the Air Corps' new northwest base, near Tacoma, Washington. This field will help to answer the question of where all the new planes will be kept.



SAID TO BE the fastest military plane in the world, Lockheed P-38's like this will soon be joining our pursuit squadrons. Powered with two Allisons, this ship can attain speeds of over 400 m.p.h. in level flight.

Matthew Grimaldi

UP IN NEW ENGLAND, the Army is going ahead rapidly with its great northeast base at Westover Field, near Chicopee, Mass. This field will soon house various squadrons for defense of the northeastern section of the country.

fused the Army all but 57 planes!

Development of lighter-than-aircraft gained impetus under Edison, who announced before resigning that the Navy would build blimps for coastal patrol and a rigid airship for experimental purposes, as well as cooperate with other agencies in developing commercial airships.

A vital phase of national defense, ignored for years by Congress despite Army and Navy pleadings, has still to be developed to full strength. That is expedition and expansion of the air base program in Alaska, a project expected to show startling growth in the near future. Reports that Russia is establishing a large military base at nearby Kamchatka Peninsula in Siberia are bringing the shocked realization that this area may prove a first port of entry for an enemy force unless defenses here are reinforced.

Alaskan Air Power

The importance of the new Alaskan air bases in the national defense program is stressed by the announcement that Russia is believed to be building a large military establishment on the Kamchatka Peninsula in Siberia. The Navy bases, having an eventual cost of some 112 million dollars, are just being started, although there has been some preliminary construction at Kodiak which has formed a temporary shore base for patrol planes. At the Unalaska base, the Navy plans to expend within the next year at least $3,500,000. The time given for the completion of the project is 24 months.

The Army air bases, built to cover the interior and to back up the Navy posts, are to be situated at Anchorage and Fairbanks. The largest of these Army depots will be the one at Anchorage. At the present time, most operations in the Alaska area are of a temporary type and it is too early to venture an estimate of the program or of the money to be spent. Much of the program is in process of incubation. With the return of General Arnold from his present inspection of the bases, something should be forthcoming. The General recently said we are trying to do in two years what Germany did in six.

Test Pilot's View of War

Marshall Headle, Lockheed's chief test pilot, recently made a round-trip Clipper hop to Europe, stopping over for seven weeks in France between May 10 and June 30. After viewing the Blitzkreig at close range, Headle came home convinced that Germany had already won this war and that the United States had better be preparing for the next one. He thought there was no adequate defense at this time against dive bomber attacks or against low flying bombing attacks against ships at sea. Headle found it hard to be too positive about many features of the French campaign, due to the confusion that existed and the lack of official sources of information, but it was his opinion that both sides had had about equal losses. Airplane replacement requirements, he thought, would run about 100 percent every fifteen days, and an average of three crews per plane needed to keep the flying equipment operating at full efficiency. He suggested that we might experiment with putting pilots in prone position for dive bombing. As one pilot to another it sounds as though it would take some doing—head rests, chin rests, special vision windows and all that—but it would solve the problem of pull-out blackouts, and it might greatly extend the human capabilities in all sorts of aerial combat maneuvers.

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. . . and every one embodying the proven Elastic Stop principle

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Proof of Elastic Stop Nut effectiveness is the fact that these nuts are used on all American and most foreign-built planes.

Write for this 56-page Catalog

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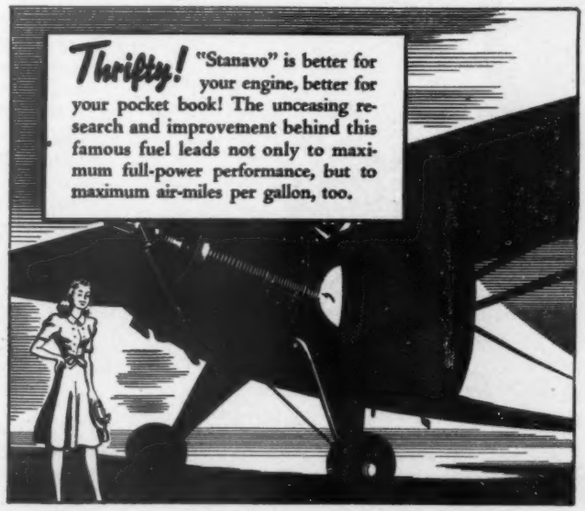
Thrifty! "Stanavo" is better for your engine, better for your pocket book! The unceasing research and improvement behind this famous fuel leads not only to maximum full-power performance, but to maximum air-miles per gallon, too.

Follow the lead of wise flyers—

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The Birdmen's Perch

Things To Do On Your Vacation:

1. **Drop a card to the boys at the office saying it's so cool at ....., you have to sleep under 3 blankets.**
2. **Let fall a ditto to your mother-in-law. Suitable message: "Miss you, like the devil!" Pray she doesn't see the comma.**
3. **Write a whopper for the Perch. Subject: Gulf Aviation Gas. From there on, you're on your own.**

Major Al Williams, alias "Tattered Wing-Tips," Mgr., Gulf Aviation Products, Gulf Building, Pittsburgh, Pa.

PERCH

POWER OF THE ~~PRESS~~ DEPT.

Last July we published a problem, about a transaction involving a hotel, a bellhop, and three guests, in which a dollar evaporated. It wasn't original with us. We got it from a nonagenarian who'd been worrying about that buck since the Battle of Shiloh. But right after the Perch pioneered it in print, a national syndicate —realizing its imperative and timely nature—popped up with the same thing. Adding slightly to the millions of Americans spending billions of hours of skull-cudgeling over it.

Well . . . another dollar's up and gone. It all happens right before your eyes in "Fantastic Finance" in the next column. WARNING: recommended for insomniacs only—not for folks who like to sleep o' nights.

THE CURSE OF VERSATILITY

We take that back. Versatility is no curse. In fact, it's a blessing in the sense that what you learn from one activity, you can often put to use in another.

For example, Gulf made automotive products—Gulf No-Nox and Good Gulf gasolines and Gulfpride and Gulflube oils —long before flying got to require the super fuels and lubricants it does today.

In experimenting on the Alchlor Process for automobile Gulfpride, we discovered that it produced an oil which *stayed clean!* That's an important quality in oil for cars but it's doubly important for an airplane oil. Add to that discovery plenty of specialized experiment and research to develop other important qualities and you have Gulfpride, the world's finest oil for planes!

That's not all. Fact is, the thing works both ways. We've learned a wrinkle or three from aviation that make a big difference in our automotive products. Why don't you stop at the Sign of the Gulf Orange Disc next time you're driving? One filling of Gulf No-Nox or Gulfpride Automotive Oil will show you that versatility pays—*you!*

FANTASTIC FINANCE

(*With a grateful bow to Albert Gray of Valley Stream, N. Y.*)

A sporting goods dealer had a sale in which he sold tennis balls at 3 for $1.00 and golf balls at 2 for $1.00.

On the last day, a customer asked how many he had left. The answer was: 30 of each. So the customer offered to buy the lot at 5 for $2.00, which the eager dealer accepted.

Late that night, he discovered that he'd have got one dollar more if he'd sold them on the original basis. But try as he would, he couldn't discover where the extra iron man came from or went to. For . . .

60 @ 5 for $2.00 = $24.00
and
30 @ 3 for $1.00 = $10.00
30 @ 2 for $1.00 = $15.00
$25.00

(Send in your idea of *where the dollar went to* to T.W.T. We'll counter with the official explanation).

THIS MONTH'S WHOPPER

Dear Major:

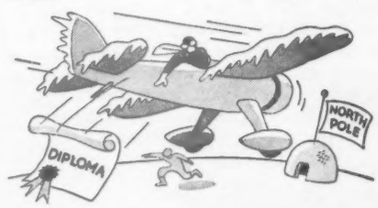
Around sundown, a flying feller dropped in here to wait out a storm. While he was here, he told me some of the stories about your Gulf Aviation Gas: how much superior it is to all other kinds of airplane fuel, and how you offer a Diploma each month for the best story of its almost incredible accomplishments.

Sundown was six months ago (don't interrupt till I finish) and since then I've been

sitting right here with a pencil in my hand trying to write a Whopper about G.A.G. myself.

But no dice. Try as I would, I couldn't get a single word—not even "Dear Major" —down on the paper.

But about 10 minutes ago, I had an idea. I went and got an extra can of G.A.G. my friend left with me in case someone else came by and needed some. I unscrewed the top and dipped in the point of the pencil. Then right away I began to write you this letter.



Guess you better send me that Diploma next time someone you know is coming this way.

Very truly yours,

Bill Blubber

P.S. In case you don't think this story is remarkable enough, let me tell you I was born and bred right here at the North Pole and never did see a pencil or piece of paper till this flying guy won a husky cub from me playing Tick-Tack-Toe just before he left! And any gas which can make a pencil write all by itself is s-o-m-e gas!

B. B.—alias I. Flore

Gulf Oil Corporation and Gulf Refining Company . . . makers of

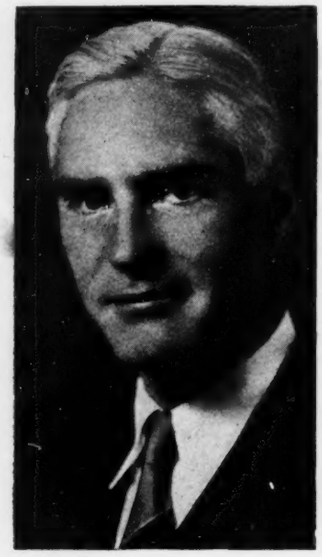
GULF **GULF AVIATION PRODUCTS**

ON BRANIFF AIRWAYS

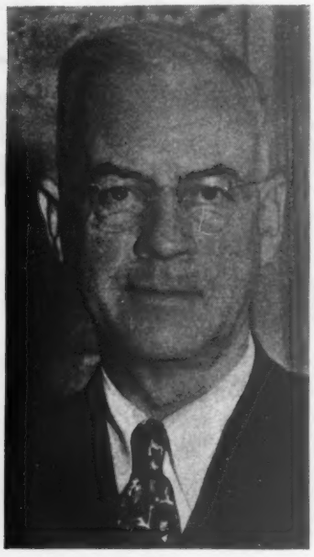
To, Through and From the Southwest Now It's DOUGLAS 100%

Now taking delivery on Douglas DC-3 "Super B-Liners," Braniff Airways has made a 60% increase in new Douglas equipment during the first six months of 1940! With its enlarged Douglas fleet Braniff retires all other flight equipment and standardizes on the same luxury service found on the major routes with which it connects from the Great Lakes to the Gulf. "It Pays to Fly Douglas"—ask Braniff. Douglas Aircraft Company, Inc., Santa Monica, California.

AVIATION PEOPLE



J. CARLTON WARD, JR., has been elected president of Fairchild Engine & Airplane Corp. Mr. Ward comes from United Aircraft Corp. where he was vice president; also general manager of the Pratt & Whitney Aircraft Division. He succeeds Shrman Fairchild, who becomes chairman of the board.



THE REORGANIZED Civil Aeronautics Authority has as its new administrator Col. Donald H. Connolly, to succeed Clinton M. Hester. Colonel Connolly is an Army engineer and has had some experience in airport construction under the WPA. Mr. Hester has retired to private law practice.

THOMAS HARDIN, chairman of the CAA's original Air Safety Board during the past year, goes with Transcontinental & Western Air as vice president in charge of safety. His career as a flyer and airline executive has made him an authority on safety in transport. His headquarters will be in Kansas City.

Harris & Ewing

ACTING SECRETARY and Consultant to the Civil Aeronautics Board is Thomas G. Early's new job. Since 1938 Early has been serving as Administrative Assistant to Col. Sumpter Smith, Chairman in charge of construction of the Washington Airport, and has also held several administrative posts.

AT A DINNER in his honor, Robert J. Minshall (right), vice-president of Boeing Aircraft Co., was awarded the Musick Memorial Trophy for 1940 by Major Lester D. Gardner, executive vice-president of the Institute of the Aeronautical Sciences. Mr. Minshall was in charge of the Boeing engineering department during development of the Boeing 314 Clippers of Pan American Airways, and received the trophy for "outstanding contributions to the safety of transoceanic air transportation through major engineering improvements in large flying boats." New Zealand established the trophy in memory of Capt. Musick.

C. B. ALLEN, of disbanded Air Safety Board, is now national defense editor of the New York Herald Tribune. The Tribune loaned him to C.A.A. for brief period only and has been trying for months to get him back. He knows Washington politics and national defense and will be a Tribune asset.

J. E. STANTON, Republic Steel official, has been named assistant to the president of Aviation Manufacturing Corp. He will coordinate the activities of industrial engineering and accounting with operations of Aviation Manufacturing Corp.'s four divisions, Lycoming, Stinson, Barkley-Grow, and Spencer.

Curtiss First

FOR PRECISE MANEUVERABILITY ON THE WATER

REVERSE PITCH

The advantage of Reverse Pitch propellers on multi-engined seaplanes has been demonstrated by the exceptional performance obtained in tests by the U. S. Navy. This unique Curtiss feature facilitates surface operations in restricted areas, permitting complete turns to be executed in less than twice the wing-span. Normally difficult approaches can be quickly negotiated under unfavorable current and wind conditions, even to backing against the wind.

Reverse Pitch is readily adaptable to the Curtiss Electric design and strongly illustrates the wide utility range of the Curtiss principle. Another "Curtiss First," it is symbolic of the same engineering leadership which pioneered Feathering, Four Bladed Propellers, Blade Shank Cuffs and many other developments.

CURTISS PROPELLER DIVISION

Curtiss-Wright Corporation

CLIFTON **NEW JERSEY**

CURTISS *Electric* PROPELLERS

BIG SHIPS CAN'T AFFORD "FLOPPY FLIPPERS"

THEIR WIDE SURFACES BLASTED by prop wash, their weight calling for strong support, their pilot demanding friction-free control – the elevators of a big ship can be a problem to mount. In this field, "Floppy Flippers" are no joke!

SO FAFNIRS ARE DESIGNED IN!

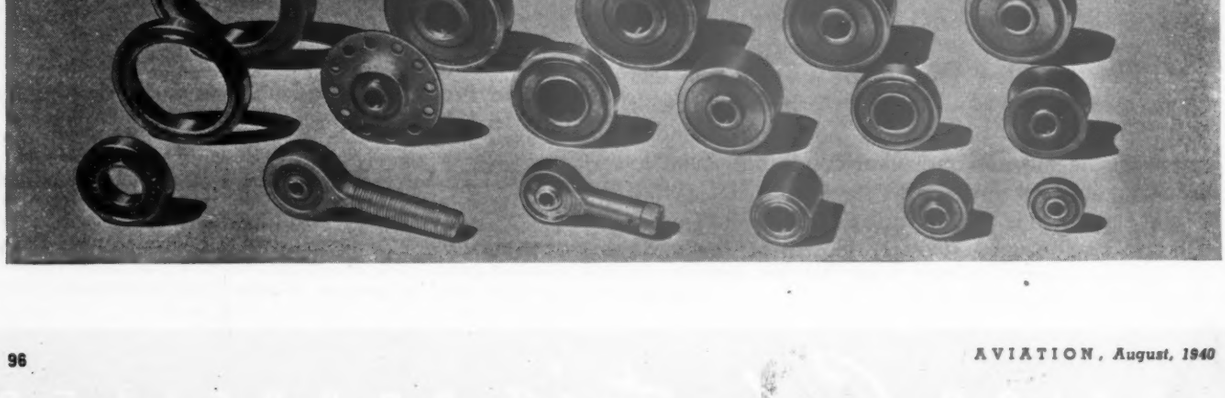
Steady in the Slipstream no matter what eddies the multiple propellers set up are the flippers mounted on the hinges shown above . . . yet in spite of their rigidity, they're responsive to the pilot's slightest touch, today or six months hence.

For this leading manufacturer has designed rigid, friction-free support right into his elevator hinges by lettering "Fafnir Ball Bearings" right on the sketches. Ball bearings for friction-freedom – Fafnirs for highest capacity/weight ratio and for *quality guaranteed.*

"Flight-tested before flight" by dozens of inspections, Fafnirs are one part of your ship that you can place in the "known performance" class. You can specify them, sure of the quality which you and all other aircraft builders have recognized for the past ten years. The Fafnir Bearing Company, Aircraft Division, New Britain, Conn.

FAFNIR *Ball Bearings* { *For Aircraft Engines and Controls*

THE BALANCED LINE — MOST COMPLETE IN AMERICA . .



AVIATION MANUFACTURING

4 Bombers A Day

Stepping up into the ranks of the major aircraft manufacturers, Courtlandt S. Gross newly elected president of Vega Airplane Co., subsidiary of the Lockheed Aircraft Corp., has announced the immediate construction of a $3,500,000 factory on a 30-acre site adjoining Union Air Terminal, Burbank. The construction contract, awarded to Simpson & Simpson, calls for completion of the plant within four months. It will have seven buildings with a total floor space of approximately 579,000 sq. ft. Three additions are provided for in the plans, to be erected as needed and represent an additional floor area of 310,000 sq. ft. Initial capacity of the plant will be four large bombers or fifteen smaller airplanes daily. Actual production is expected to be under way before the first of the year. When the plant reaches its full productive capacity it will employ between eight and ten thousand persons.

In addition to enclosed floor area, the plant will have a paved ramp 1,450 ft. long and 150 ft. wide, providing 218,000 sq. ft. of useable area for outside final assembly work, equipment installation, etc.

Buildings of the new Vega plant will represent an outlay of about $2,000,000; machinery and equipment another $1,500,000. Vega will continue to manufacture component parts for aircraft (including engine mounts, firewalls, cowlings and exhaust manifolds) in the present factory, also located in Burbank, where approximately 1,400 persons are now at work. Gross disclosed the fact that his company also plans to engage in the manufacture of aircraft armament.

300th DC-3 Delivered

While war planes roared across Europe early in July, the Douglas Aircraft Co. typified the spirit of peaceful accomplishment of the American aviation industry through the delivery of the 300th Douglas commercial transport plane. Of DC-3 type, the plane was delivered to American Airlines. Douglas production and employment figures continue to surpass previous astronomical totals. As of July 1, employment has mounted well beyond the 18,000 figure, payroll is currently at the rate of $30,000,000 annually, and backlog exceeds $140,000,000. A $200,000 addition to the El Segundo plant is under way, providing 112,000 sq.ft. of additional manufacturing space. This will make room for an additional 1,100 new employees.

Lawrance Engineering Expands

Late in 1939 a small engine for use with auxiliary power plants, manufactured by the Lawrance Engineering and Research Corporation, was installed in a PBY-2 Patrol Bomber for service test. The 150-hour test was successfully completed and orders were received. To produce the unit on a quantity basis, the company is more than doubling its machine shop and manufacturing facilities at Linden, N. J. The new building will contain the machinery for fabrication of parts of the engines, as well as the assembly, inspection and testing. The present structures are being revamped for drafting room and office quarters. Cost of the additions and revisions will approximate $45,000, and machinery will be ready for installation upon completion of the building program. Personnel of the company is Charles L. Lawrance, president; Hugo Rutherford, vice-president; Norman N. Tilley, chief engineer; Richard Uhl, treasurer; Silas C. Snyder, sales manager; John K. Munningham, Seth P. Stugart, purchasing agent.

Lockheed Doubles

Expansion of production facilities of Lockheed Aircraft Corp. and its subsidiary, Vega Airplane Co., to triple or quadruple aircraft output in order to meet the current national defense need, has been announced by Robert E. Gross, Lockheed president. The new building program calls for additions to the two Burbank plants that will more than double present facilities, adding approximately 1,067,000 sq.ft. of additional floor space. Cost of the program will be about $4,000,000, but no new financing will be required. Work had been under way for several weeks prior to the announcement. One of the first units to be erected is a 60x148 office building costing $48,000 and now nearing completion.

Delivery of 17 a Week

Vultee Aircraft, Inc. has put its new plant on full production with delivery of seventeen airplanes during the last week of June. Production continues on a 24-hr. day basis and July production is scheduled to run double that of June. The company also has a major plant expansion program under way in order to meet the pressure for foreign deliveries, in addition to planes being built for the U. S. Army Air Corps.

Ryan Expands

Ryan Aeronautical Co., San Diego, broke ground July 11 for a factory expansion program that will more than double production area. The present factory is less than a year old. The principal addition, 200x275 ft., is the same size as the original building and adjoins it on the west. An additional extension 50x200 ft. in size is also being erected on the south end of the original building. Both new units are of steel construction, with sawtooth roof, and represent an investment of $200,000 for construction and new equipment. Total area of the new Ryan plant will be approximately 160,000 sq.ft. Urgency of the expansion program was illustrated when, with several large orders pending, a single order for $800,000 was placed by a foreign government on July 18. This is the largest single order in the history of the Ryan company and calls for delivery of Ryan STM-2 type military monoplane trainers of both landplane and seaplane types. Power will be provided by Menasco 150 hp. supercharged engines.

UNITED AIRCRAFT CORP. announces six new appointments: Charles H. Chatfield, (l.) appointed executive assistant to the vice president, was an aeronautical engineer for Pratt & Whitney for six years, and since 1935 has been director of research. Frank W. Caldwell, (r.) his successor, has been identified with Hamilton Standard Propellers for the past eleven years, was responsible for the development of the controllable-pitch propeller, and received the Sylvanus Albert Reed Award in 1935 for propeller design. Taking his place as engineering manager is Erle Martin, chief engineer since 1935, who contributed to the development of the feathering propeller. Joseph M. Barr, named factory manager of the Vought-Sikorsky division, joined the company in 1932. James J. Gaffney, new assistant treasurer of Vought-Sikorsky, chalks up eleven years with the company in various capacities. Succeeding him as assistant secretary and treasurer of Pratt & Whitney is William R. Robbins, connected with United Aircraft since 1936.

New Menasco Plant

Announcing a major expansion program designed to meet the current need for aircraft engines in the small power range, A. E. Shelton, president of Menasco Manufacturing Co., has revealed plans for immediate construction of an entirely new aircraft engine plant of modern design and construction in Burbank, Calif. At the same time Shelton disclosed the appointment of Robert Insley to the post of vice president in charge of engineering. Mr. Insley, a graduate of M.I.T., comes to Menasco from the Pratt & Whitney Aircraft division of United Aircraft Corp., where he was assistant chief engineer in charge of new engine development.

The new Menasco plant at Burbank is located on a 10-acre site and will have a floor area of 55,000 sq.ft., plus an administration building of 8,500 sq.ft. New equipment will be installed and the plant is to be in operation by Oct. 1.

CIO Names Bargainer

Following a campaign of many months to secure an opening wedge in its efforts to gain control of the 50,000 Southern California aircraft workers, the CIO United Auto Workers was named the bargaining agent for production employees of Vultee Aircraft, Inc., Downey, by a vote of about three to one. The election was conducted under the direction of the NLRB. Petitions for similar elections are being sought by CIO organizations for the Ryan Aeronautical Co., San Diego, North American Aviation, Douglas Aircraft Co., Lockheed Aircraft Co., and Northrop Aircraft Corp., all in the Los Angeles area.

Chute the Nylon

Irvin Airchute, and perhaps other makers, are turning out Nylon parachutes which Army and Navy are testing. England also is testing Nylon. This fabric is woven from a new thread made by du Pont, as fine and elastic as silk, and stronger. No reports are out, but service experts hold no doubt synthetic cloth will supplant silk. Nylon still costs as much as silk, but soon will be cheaper. The main point is that we depend on Japan for silk. Even if synthetic goods failed and silk were shut off, we still would sit pretty in the harness, because good cotton chute cloth has been perfected. It's a little bulky and heavy, but ok.

THREE NEW DIRECTORS have been elected to the board of Curtiss-Wright Corp.: E. S. Bloom, Charles A. Dana, E. S. Cramer. Mr. Bloom was president and director of Western Electric Co. from 1926 to 1939. Mr. Dana is president of Spicer Manufacturing Corp. and is associated with several other organizations. Mr. Cramer has been with Curtiss-Wright since 1929, was elected treasurer and secretary in 1935.

$30,000,000 Vega Order

Vega Airplane Co. has received a contract to build a quantity of new-type twin-engined bombing planes and spare parts for the British Government at a cost of approximately $30,000,000, according to Courtlandt S. Gross, president. The order represents a subcontract from Lockheed Aircraft Corp. The planes, a military version of the Lockheed Lodestar, will be known as the Lockheed-Vega Model 37 and will be manufactured in the new $3,500,000 Vega factory now under construction.

The Harlow Aircraft Company of Alhambra, California, has acquired a one-third interest in the Porterfield Aircraft company of Kansas City, it was announced recently by E. E. Porterfield, Jr., head of the Kansas City concern. Plans are underway for the production of a small, all metal light plane, to be manufactured by the combined companies, production to begin next year. A more expensive plane, the Harlow, will be built in the Alhambra plant. No immediate change is contemplated in the production schedule at the Kansas City plant which is turning out ten and twelve planes per week, nearly triple the May-June weekly output. Demand for training craft accounts for the increase in production which has also doubled the number of employees and made necessary the acquisition of additional floor space. Floor space at the plant now totals 52,000 sq. ft. The new building, at 1409-11 Kansas Avenue, near the other two Porterfield buildings, will be used as the wing construction shop.

Commenting upon the difficulty of obtaining trained men, Mr. Porterfield announced that he would inaugurate a training school shortly for aircraft workers to instruct men for his own plant and other aircraft factories. A two-month course is contemplated with facilities to train 150 men per month.

The pay roll at the Porterfield plant now is about $12,000 monthly.

Brewster is following its usual policy and looking to automotive plant for space. It is doubling its capacity — to 884,000 sq.ft.—by leasing a Ford assembly plant at Long Island City. Its present plant was formerly owned by Pierce-Arrow, and it started business in the Rolls Royce-Brewster body plant.

Propeller production at Curtiss-Wright's Clifton, N. J., and Pittsburgh plants combined will be equalled by a new plant being erected at Caldwell, N. J. Production at the 230,000-sq.ft. plant is scheduled to start in October.

Douglas is beginning its latest expansion program with a $200,000 addition to the El Segundo plant which will provide an extra 112,000 sq.ft. of space. Further expansion plans are waiting definition of the government's program.

Packard will make the 3,000 Rolls Royce engines for this country and 9,000 for Britain. Ford was originally scheduled for the job but backed out, whether because of pacifism, politics, fear of falling down on the job, or what, is not known. Packard expects to turn out twenty engines a month in ten months and be up to 840 a month in fifteen months.

French war materials orders were all taken over, after the defeat of France, by the British Purchasing Commission.

Recent Awards

War Department

United Aircraft Corp., East Hartford, Conn., $103,775 for propeller blades.

Curtiss-Wright Corp., Clifton, N. J., $95,022 for propeller assemblies, controls and brush housings.

The B. G. Corporation, New York City, $14,417 for spark plugs.

Champion Spark Plug Co., Toledo, Ohio, $48,452 for spark plugs.

Bendix Aviation Corp., Bendix, N. J., $69,441 for oxygen regulator assemblies.

Navy Department

Spartan Aircraft Co., Tulsa, Oklahoma, $1,859,880 for airplanes.

The National Supply Co., Holmesburgh, Penna., $219,100 for engines.

Wright Aeronautical Corp., Paterson, N. J., $562,951 for engines.

National Forge & Ordnance Co., Washington, D. C., $17,275 for propeller shafts.

Engineering & Research Corp., Riverdale, Md., $81,100 for blades for test clubs.

Wright Aeronautical Corp., Paterson, N. J., $58,567 for engine.

Aviation Mfg. Corp., Williamsport, Penna., $11,492 for airplane wheels.

Wright Aeronautical Corp., Paterson, N. J., $36,304 for engine.

United Aircraft Corp., East Hartford, Conn., $80,380 for engine.

Tucker Aircraft Corp., Detroit, Mich., $105,000 for engine.

Aviation Mfg. Corp., Williamsport, Penna., $1,541,448 for aircraft engines.

Continental Motors Corp., Muskegon, Mich., $1,442,275 for aircraft engines.

Stearman Aircraft, Wichita, Kansas, $3,779,628 for airplanes and spare parts.

TO MEET NATIONAL DEFENSE NEEDS, Vultee Aircraft is more than doubling its plant facilities. Floor area is being expanded from 331,000 square feet to 802,000.

REARWIN'S NEWEST BID for the lightplane business is this model which is supplied with either a 65 or 75 hp. Continental engine. Ship has a 2S rating, cruises at 100 m.p.h.

Grumman Aircraft Engineering Corp., Long Island, New York, $29,492 for spare parts for airplanes.

Karl L. Hermann, South Bend, Indiana, $198,000 for aircraft engine.

Calling Names

Wings Over the Americas is a swell story of flying around South America by Alice Rogers Hager, new press boss, CAB.

Don M. Parker appointed assistant director of export, Republic Aviation.

C. M. Weaver, superintendent of maintenance of United Air Lines, goes to the Boeing Aircraft Co.

John D. Ackerman, head of aero engineering, University of Minnesota, joins Ed Allen on Boeing research for the summer.

Ailor Fly-Ur-Self is a new thing, just what it sounds like, at Roosevelt Field. Howard Ailor is the boss.

1940 Collier Trophy will be awarded by nine men just appointed by NAA.

Glenn L. Martin says his new airport will be finished Sept. 15.

Department of Interior offers large tracts of land to Army and Navy for bombing ranges.

Theodore W. Cate, prominent Los Angeles advertising executive, has been appointed advertising and promotion manager for Western Air Express. At the same time it was revealed that **Frederick S. Cowen** has been given additional duties and will now direct the Los Angeles traffic office.

Carleton E. Stryker, Pacific Coast aircraft engineer, has been appointed to the headquarters staff of the Society of Automotive Engineers to take charge of the Society's national defense responsibilities.

H. G. Lesley, assistant superintendent of maintenance, EAL, is the author of a book entitled "Airplane Maintenance," to be published Oct. 1.

Separate Aeronautics Department proposed in a bill before House of Representatives. No chance now.

To James Robinson, ace model builder in Tennessee, a job in Stinson plant at Nashville.

The Immigration Service is going streamlined with the announcement of an appropriation for three autogiros which will patrol the Mexican Border.

Lieut. Roy Watkins, senior production engineer for Lockheed Aircraft Corp., has resigned to accept a position as vice-president and works manager of the Beech Aircraft Corp. of Wichita, Kansas.

Edmund Kelly, formerly associated with Ryan Aeronautical Company, Vultee Aircraft, and Aircraft Accessories Corp., in a sales capacity, has formed Aviation Equipment Sales Company in Los Angeles. The new firm will undertake Pacific Coast representation for Eastern aircraft equipment manufacturers.

T. C. Coleman, formerly vice-president of Banks-Huntley & Co., Los Angeles investment house, has been named to fill the position of secretary of Northrop Aircraft, Inc..

Capt. Joe Glass, American Airlines, is first captain to fly 2,000,000 miles. Flying time about 17,000 hours.

Standard Oil announced the signing contract with American Airlines for more than 3,000,000 gallons of gasoline.

National Aviation Agency formed by W. W. Rice, with headquarters in Chicago, dealing exclusively in aviation insurance and finance.

Eastern Airlines celebrates first birthday of the Philadelphia autogiro rooftop airmail.

James Fateux has taken over the duties of Duluth, Minn. traffic manager for Northwest Airlines.

Theon Wright will head newly combined public relations and news divisions of TWA.

Col. Louis Johnson, Asst. Secretary of War, flew with other notables in American Airlines Flagship from Washington to dedicate the Clarksburg, W. Va. Airport.

American Airlines, Inc. opened its first downtown Syracuse, N. Y., office in the Onondaga hotel.

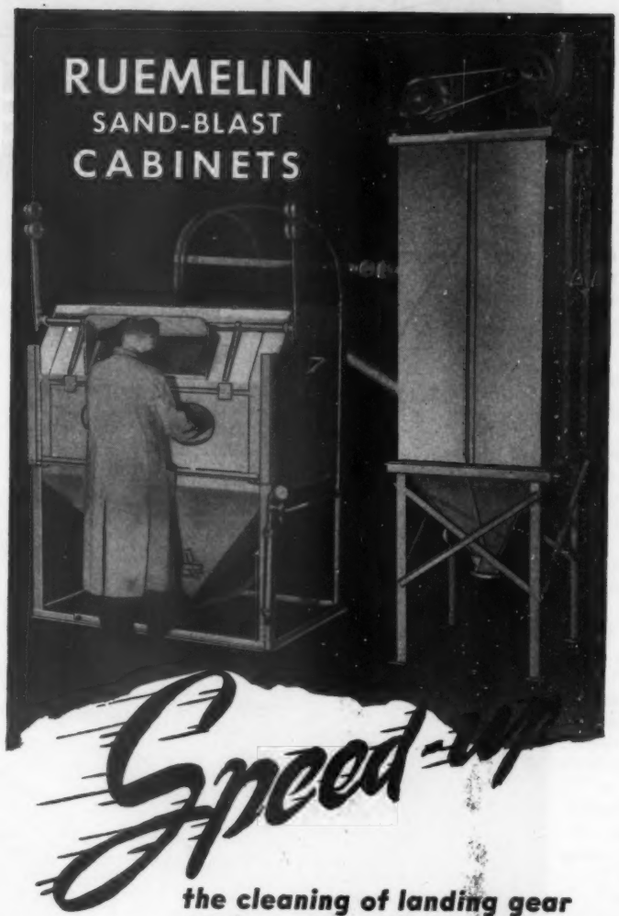
Aeronautical Chamber of Commerce announces the "Aircraft year Book for 1940". Edited by Howard Mingos.

C. A. DuRose, will head the new Northwest Airlines department for handling "unpreservations".

Air Transport Association goes stylish sponsoring new rayon called "Sky Flight Prints".

William P. McGrath, formerly g. m. of the Anchor Steamship Lines, appointed eastern manager of traffic and sales for TWA.

Britain is accepting in RAF subjects with flying experience, now resident in the U. S.



Speed-up

the cleaning of landing gear parts and sub-assemblies with this new, highly efficient, sand blasting equipment.

• **AIRCRAFT** manufacturers are finding Ruemelin Sand Blast Cabinets a valuable aid in maintaining production schedules. They put sand-blasting operations on a faster, more efficient basis for cleaning parts after welding or annealing. Sand or steel abrasives used. Simple to operate. No skilled labor needed. Built for long, continuous trouble-free service. Widely used by U. S. Government air defense forces and private airports for maintenance work. Cabinet made in many sizes.

Write for literature on our complete line of sand blast equipment, dust arresters, fume collectors and compressed air dryer systems.

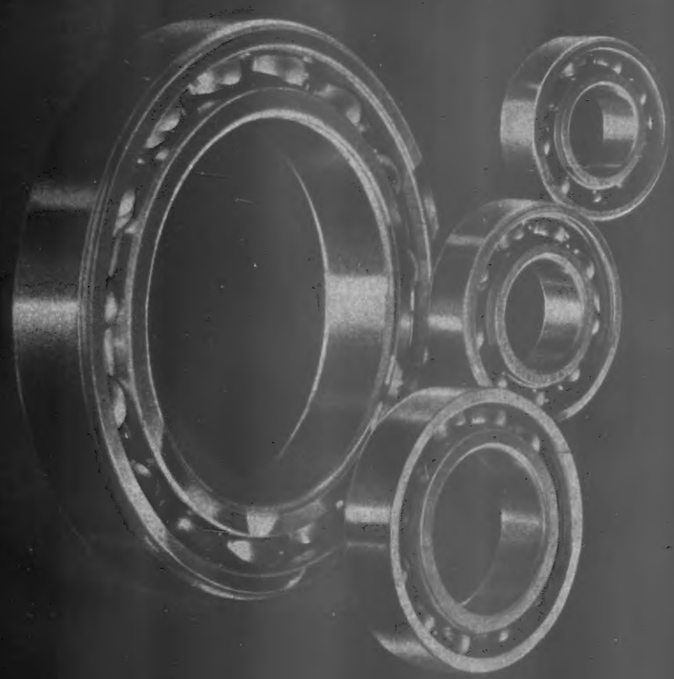
RUEMELIN MFG. CO.,
3875 N. Palmer Street **Milwaukee, Wis.**
Western Sales Engineer
Richter Bros., P.O. Box 172, So. Pasadena, Calif.

RUEMELIN

EXPERIENCE . . .

Foundation of Outstanding Quality

● In manufacturing highly specialized precision products, such as New Departure ball bearings, there is no short cut to the knowledge and skill gained by long experience. The superiority of the methods, materials and the products resulting from New Departure's fifty years of manufacturing experience is recognized wherever bearings are used. New Departure, Division of General Motors, Bristol, Connecticut.



NEW DEPARTURE

THE FORGED STEEL BEARING

AVIATION ENGINEERING

At the West Coast Meetings of the Institute of Aeronautical Sciences

By

Charles F. McReynolds

West Coast Editor, AVIATION

The Second Annual Summer Meeting of the Institute of the Aeronautical Sciences certainly brought to light a great many advanced ideas which will doubtless have a profound influence on any future war effort that might involve America. If the papers presented there did not startle audiences with revolutionary new ideas, they certainly did present a variety of new ways for doing the same old things. In fact, so militarily significant were some of the ideas that our massive Army Intelligence Service clamped down on at least one paper, refusing permission for presentation of a discussion of the characteristics of rocket motor propulsion, by F. J. Malina.

This meeting of the Institute of the Aeronautical Sciences was among the best yet staged by that commendable organization. Papers were of a uniformly high quality of profundity and the audiences were commendably large and "open-mouthed". Paraphrasing our own American phrase maker, "they may not all have understood all that they heard all of the time but some of them understood some of what they heard some of the time."

Attendance at the meetings was led by such men as Dr. Von Karman, Dr. Millikan, Dr. Klein, Dr. Klemperer, Hall Hibbard, Richard Palmer, and many others of the American aviation industry's scientific and engineering greats. Papers presented during the three days, extending from June 24th through June 26th, greatly extended the industry's knowledge of such subjects as airplane cabin pressurizing, vibration and flutter phenomena, radio shielding and bonding problems, recording of flight test data, characteristics of engine combustion, etc. For convenience the papers were grouped into five sessions under the five general headings: structures, vibration and flutter, instrumentation, high altitude flying, and aerodynamics.

V. H. Pavlecka, Northrop Aircraft, Inc., served as chairman for the opening session on structures. A paper prepared by W. L. Howaland and Carl Beed, Lockheed Aircraft Corp., was presented by Carl Beed. The authors called attention to present requirements which demand aircraft with wings so thin as to be invisible when seen from the front, yet thick enough to carry fuel tanks, supercharging equipment, retracting gear, etc. Since these items must not be hampered by structural members, the wing structure is reduced to a series of load carrying holes. The fuselage design problem is somewhat simpler, requiring only that the fuselage be large on the inside and small on the outside, and capable of pressurization. This paper then presented the results of pressurized cabin structure tests which have been conducted by Lockheed Aircraft Corp. in preparation for construction of the new four-engined Lockheed transport, "Excalibur", and other high-flying Lockheeds. The audience was reminded that the world's first full-scale pressurized plane was the special Lockheed transport built for the U. S. Army Air Corps about three years ago, which made many notable high altitude flights. In conducting pressurizing tests Lockheed engineers worked with a cabin section specially mounted to permit application of structural loads with and without pressure. A complete set of tests was first made without fuselage cutouts, which was followed by an extensive investigation of structural requirements imposed by various types of cutouts. An electrical strain gauge of Baldwin-Southwark type was used for stress measurements. One of the major structural problems of the pressurized cabin is the "quilting" effect by which the pressure tends to bulge the thin sheet covering between the support frame. Interestingly enough, while the longitudinal stiffeners bulge outward, the unsupported skin itself bulges inward slightly at about the center point of each panel. It was also found that the fuselage structure was stronger for some conditions of loading while pressurized. Discussion following the paper revealed that spot welded portions of the section tested were smoother and more rigid under test. A weight saving was also achieved through elimination of the sealing compound necessary with riveting.

C. S. DRAPER

E. P. WHEATON

CLARK B. MILLIKAN

A. D. TUTTLE

Symposium on Structures

A symposium on Stability of Aircraft Structures was presented by Alfred S. Niles, Stanford University; Louis G. Dunn, California Institute of Technology; N. J. Hoff, Stanford University; John C. Silliman, Pacific Railway Equipment Co.; and J. L. Frederick, California Institute of Technology.

J. R. Goldstein served as chairman for the Monday evening meeting, devoted to "Vibration and Flutter". A paper on the "Effects of Propeller Slipstream and Tail Position on the Vibration Characteristics of the Lockheed 'Lodestar'," by R. L. Thoren and C. L. Johnson, Lockheed Aircraft Corp., was presented by R. L. Thoren. It was encouraging to learn of the exhaustive program of flight testing conducted on this model in order to eliminate all vestiges of vibration. Instrumentation was explained in detail although about equally accurate results were said to have been obtained by the observations of a recorder sitting on a wooden stool in the lavatory compartment. During the discussion period it was suggested that flutter research might be made less expensively by means of powered wind tunnel models. Dr. Clark Millikan, of Cal.-Tech, suggested that the results might be adversely affected by the proximity of the tunnel walls, a factor difficult to evaluate in connection with tests of this character.

Engine Propeller Systems

"Coupled Oscillations of Aircraft Engine-Propeller Systems" was presented by M. A. Biot, Columbia University, in an interesting mathematical method of analyzing such vibrations.

E. P. Wheaton, Douglas Aircraft Company, presented a paper dealing with "Flutter: A Diagnosis, Its Prevention and Cure", by Jean Wylie, and Wheaton. This study was based on a series of tests involving artificial excitation of the wing structure. Elliott Mock questioned the conclusion that flutter frequency would be reduced

during pullout from a dive due to reduced elasticity of the wing. Wheaton thought that reduction of frequency was a normal phenomenon up to the point of skin wrinkling. "A Graphical Solution of Flutter Instability", by W. B. Bergen and Lee Arnold, The Glenn L. Martin Co., was presented by Bergen. Representing a long step towards elimination of flutter, this paper presented a set of graphs and mathematical curves which were designed to help the engineer arrive in a few minutes at computations that once required weeks of mathematical gymnastics. The long period of intensive vibration study conducted by Martin engineers was outlined.

New Test Recorder

Tuesday's session on Instrumentation was presided over by Dr. E. E. Sechler, of California Institute of Technology. "The General Use of a Magnetic Steel Tape Recorder in Airplane Testing", by James B. Darragh, Jr., Lockheed Aircraft Corp. was well received. This interesting device, the first ever built, has numerous advantages. Using eight recording magnets and 1800 feet of steel tape driven by a variable speed magnet, it is possible to record various electrical impulses, including those from a microphone. Thus the instrument records the voice as well as the results reported by various instruments. Separate magnets are used, on the ground only, for erasing the tape. A continuous recording for as long as 16 hours may be made. Recordings are permanent until erased. Time reference points are marked on the tape by periodic short circuiting of the current. The device is especially adaptable to noise, vibration, and flutter recording, but may be used to record data from any number of flight instruments up to sixteen, simultaneously. Or as many as sixteen different observers may record data simultaneously by using separate microphones. On single-seater planes the device may be mounted with convenient remote controls so that the pilot can dictate a full account of observations at the same time that instrument, noise, stress, and vibration recordings are being made automatically. In the event of a fatal crash the record on the steel tape would be preserved except in event of a fire hot enough to destroy the magnetism of the tape. In commenting on this remarkable development, Dr. Klein pointed out that photographic recording of flight data had not proved entirely satisfactory, due to time element to get films developed, and record and assemble data, etc., but that he preferred direct visual readings wherever possible. Darragh thought the choice might be a matter of opinion but pointed to the versatility of the electromagnetic recording instrument. Dr. Klein admitted that pointer instrument readings are hard to make accurately.

J. B. DARRAGH JR.

WM. WHEATLEY

N. B. MOORE

FRED FOULON

"The Application of an Electromagnetic Indicator to Internal Combustion Engine Problems", prepared by C. S. Draper, J. H. Lancor, and Leighton Davis, of Massachusetts Inst. of Technology, was presented by C. S. Draper.

Pointing out that future engine refinements must come through exact and painstaking research into the exact nature of engine operation, Draper outlined the years of work that have gone into development of the recording instrument he and his associates have perfected. This instrument has proved far superior to any previously used recording device for obtaining indicator cards on the pressure cycle of high speed internal combustion engines.

Russell G. Robinson, of the N.A.C.A., presented a slow motion study of internal combustion. Motion pictures taken at a speed of 40,000 frames per second were shown. This is made possible by an ultra high speed camera developed at the N.A.C.A. laboratories during the past year by Cearcy D. Miller.

High Altitude Flying

Hall L. Hibbard, Lockheed Aircraft Corporation, served as chairman of the Tuesday evening session on High Altitude Flying. The highlight of the entire meeting was probably the demonstration given during that session of the high altitude pressure chamber of the new oxygen face mask, both developed in the high altitude research laboratory of the Mayo Clinic. This presentation was made jointly by Drs. Walter M. Boothby and W. R. Lovelace. The latter established a new decompression record when he was taken to an altitude equivalent, within the chamber, of 40,000 ft. in 9 minutes, returning to sea level in 2 min. 45 secs. Prior to making this demonstration Dr. Lovelace took oxygen through the Mayo face mask for forty minutes, and also used the mask throughout the test. This eliminates nitrogen from the blood system and prevents formation of bubbles in the blood during the test. It is these blood bubbles which are the chief danger to high altitude pilots. Formed through boiling of the blood due to reduced pressure, such blood bubbles will cause reduced vision, paralysis, double vision, unconsciousness, or even death. Dr. Boothby remarked that this country needs a large number of decompression chambers in which to train military high altitude pilots. Whereas we have less than a dozen such chambers now in service, Germany is known to be using hundreds of them.

Wednesday's concluding session, on Aerodynamics, was led by Dr. Clark B. Millikan, of California Institute of Technology. A paper titled, "Performance Dictates Design" by Ralph H. Upson, Wayne University, was read by Harold Luskin. The mathematics of this paper was pretty imposing and is probably a real contribution to engineering, but it was too deep for this observer. Major conclusion seemed to be that optimum performance could be reached with an aspect ratio of about 21 to 1. In any case the formula developed by Upson does permit easy examination of various design factors to determine influence on overall efficiency of their variations. Dr. Millikan, in discussing the paper, pointed out that all engineering is as much an art as a science, and that there is a point beyond which complex formulae cannot be carried from an engineering standpoint.

"Experiments on Drop Impingement" by W. H. Hunter, The B. F. Goodrich Co., outlined a program of research on icing. The speaker told his perspiring audience that ice hazards are neither seasonally nor geographically restricted. Smoothness of the wing surface is very important as, under icing conditions, a large volume of water is passing back along the wing very close to the boundary layer. Results of ice formation research are making possible a much greater percentage of flight completions to destination.

Propeller Design

"Some Recent Developments in Propeller Blade Design" was discussed by Louis H. Enos, Curtiss-Wright Propeller Division, Curtiss-Wright Corp. Enos forecast six-bladed propellers for the near future, of dual rotation type with three blades turning in each direction. He demonstrated why the hollow steel blade holds the greatest promise for propeller weight reductions. Steel blades also have superior resistance to abrasion. Propeller blade shank cuffs were described in some detail, their major advantage being improved engine cooling, but little hope was suggested for an early increase in propeller efficiency.

"Range at Constant Speed", was presented by its author, Norton B. Moores, St. Louis Airplane Division, Curtiss-Wright Corp. This paper provided a mathematical short cut method for determination of maximum range.

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TRANSPORT AVIATION

Pan American Push

Washington (AVIATION BUREAU)—It would be difficult to overestimate the importance of Pan American Airways' constant pushes to new frontiers in the present international struggle for world position. Most vital to the interests of the United States just now is PAA's expansion on the South American lines.

This is the company's own summary of results of the down-south changes: fourteen services each week between North and South America—two links between the continents for mail, passengers and express every day; ten trips a week between the U. S. and the Canal Zone; four trips a week between the U. S. and San Juan, Puerto Rico, site of the new Navy air base; plus the multiple daily trips to Havana, Nassau and Mexico City. There are new schedules galore, which would take too much space to detail here; there is a new diagonal route from Peru across Bolivia to the Argentine. The 21 American countries, including this country, are tied together on shorter time basis than the United States is by rail. The U. S. will have more route-mileage in S. A. than all of Europe's subsidized lines combined.

There are more plans in preparation for South American expansion of PAA, of vast importance but which have not yet been made known by the company or by the Government. Integration of the western countries is one of the greatest projects in the world at this time, and air transport is a major part of it.

Even more spectacular is the beginning of service from San Francisco and Los Angeles to Australasia via Honolulu and Canton and Noumea Islands to Auckland, New Zealand. This is an 8,000-mile run; it will take 4½ days as compared with 17 days by steamer. Service was started July 12. Passengers will be taken on in about 30 days from start. Britain is trying to operate a service from Sydney, Australia, to meet PAA, but is short of equipment at present.

On the Atlantic, PAA started three 24-hour services instead of the previous two on June 18. This is the "first line" of communication between this country and Europe, since surface shipping has practically stopped due to the war. The Seattle-Alaska service has been in operation for some weeks.

International

TWA is breaking all airline speed records these days with its fast Boeings. This particular ship streaked from L.A. to N.Y.C. in 11 hours, 45 minutes. Capt. Jack Zimmerman, shown here, chief pilot of eastern division, flew the last lap.

Ask Raise, get Cut

United Air Lines asked the Civil Aeronautics Authority for higher mail rates, beginning July 1, and got lower rates instead. The company is filing a petition for reconsideration. Cuts on UAL's two main lines, No. 1 transcontinental and No. 11 along the Pacific Coast, hurt the worst. CAA followed the precedent set in the Northwest Airlines decision, abolishing weight credit trips and computing the rate upon the basis of all miles flown with mail. United says that even before the new rate, its pay was less than the average of all lines; now it will be much lower. The company also complains that it applied for the rate adjustment twenty months ago; that hearings were completed fourteen months ago. President W. A. Patterson estimates that the new rate will lose the company $150,000 a year.

6 Blind Landing Systems Ordered

On July 15 the CAA placed an order for six blind landing installations with the International Telephone Development Company, the I. T. and T. subsidiary which installed similar demonstration equipment at the Indianapolis Airport. The order, which amounts to $537,547, calls for installations at La-Guardia Field, N. Y., at the Municipal Airports at Chicago, Cleveland, and Kansas City, Mines Field, Los Angeles, and Meacham Field, Fort Worth. The order marks the latest issue of the long development program, not unmarked by controversy, which has been under CAA guidance. The equipment to be manufactured and installed under the new order is substantially the same as that demonstrated at Indianapolis, which received the approval of a Committee of the National Academy of Sciences specially formed at President Roosevelt's request to investigate the matter. No date for the completion of the installations was announced.

AEA Gets Certificate

Washington (AVIATION BUREAU)—The Civil Aeronautics Board granted two temporary certificates to American Export Airlines to operate between New York and Lisbon, Portugal, via Bermuda and the Azores. One of the certificates authorizes carriage of passengers, mail and express. The other is for mail and express only, and is good until Sept. 1, 1941. The line's present equipment, a Consolidated twin-engined boat, will be used until the non-passenger certificate expires. After that the company will use three Sikorsky S-44s which it now has on order. The S-44s are Sikorsky's commercial version of the Navy bomber.

C.A.B. decided that the importance to this country of trans-Atlantic service justified the addition of a second American line. In its order, the Board discusses its conclusions from argument presented by Export, and by Pan American, which intervened against Export's application. The Board

A SHIFT in the sales department of Lockheed Aircraft Corp. takes S. W. Voorhees, left, to New York, to run Lockheed's Eastern organization. He is succeeded as assistant sales manager by Thomas H. Corpe, who has been in charge of the company's promotional activities, and was until recently sales manager for the Vega subsidiary. Mr. Voorhes has been with the Lockheed sales organization since 1935, and has made several business trips through South America and Europe.

reasoned that continuation of the PAA monopoly was not in the public interest, since passenger and express rates are not controlled in U. S. flag foreign service. Pan American argued that it could not maintain a monopoly, since other countries soon would start competitive lines.

Export long ago applied for a route between New York and Marseilles, Southamption and Rome. The Board has dismissed this without prejudice, which means the application can be renewed when the neutrality law is repealed.

With Sikorsky boats, Export expects to make the trans-ocean run, with a crew of 11 and 12 passengers, in 20 hours 30 minutes eastbound, and 24 hours 45 minutes westbound. This would be the first Atlantic nonstop service. The company has made three round-trip survey flights with the Consolidated. Mr. Sikorsky himself testified at hearings that his ship will perform as claimed. The estimated cruising speed is 175 m.p.h. Schedules will be integrated with American Export Lines surface ships. These ships will contribute weather information to air equipment by radio.

Export had applied also for permission to place its air division under control of its shipping division. C.A.B. dismissed this application on the ground that it does not have jurisdiction.

Penn-Central is authorized by CAB to stop at Erie, Pa., on its Pittsburgh-Buffalo run. Edward Sullivan, traffic manager, announces May traffic increase of 69% in revenue passengers over May of a year ago. This is the 23rd consecutive month that passengers have shown an increase over the same month of preceding year.

TWA inaugurates the first scheduled four-motor transcontinental service with five new Boeing "Stratoliners" in operation. The new service will be almost two hours faster on both east and westbound flights. A new high in food service will be established when two TWA hostesses serve meals three miles up.

Northwest Airlines announces a special circle tour for vacationers to see America first, covering the west and northwest. A seventh round trip between the Twin Cities and Chicago was inaugurated June 22.

Canadian Colonial announces filing with CAB for a certificate of c. and n. between LaGuardia field and Boston, and its intention of filing for a c. and n. to fly mail and passengers between New York and the Bahamas. Reported purchase of two Douglas 21-passenger Clubplanes.

Seaboard Railway files application with CAB for permission to operate an airline from Boston to New Orleans via Miami. A subsidiary of the railway has been capitalized at $4,500,000 to conduct the operation.

Braniff is marking its 12th birthday by retiring the last of its ten passenger transports in favor of new Douglas 21 passenger "Super-B-liners". Announces an air-rail agreement with Kansas City Southern-Louisiana & Arkansas Railway lines.

TWA, upon the acquisition of 15 new Douglas 24-passenger transport planes, will have a total fleet of 55 modern transports, including 5 new 4-motor "Stratoliners". The new Douglas planes are the most modern version of the DC-3, having a longer cabin than the 21-passenger models.

Western Air Express Corp. is proceeding with plans for expansion of service to Lethbridge, Canada, to make direct connection with Trans-Canada Air Lines and Yukon & Southern Airline, now that the CAA has denied the company the right to merge with United Air Lines.

CAB decisions: EAL gets two new routes, one is St. Louis-Nashville; the other is Forence-Sheffield-Tuscumbia (Ala.) to Nashville. UAL permitted to include Red Bluff, Calif. in its coast run.

AIR TRANSPORT INDICATOR

July 1, 1940

175.9

Which is the ratio of passenger-miles reported by the Air Transport Association for all domestic lines for June, 1940, to the figure for June, 1939. Total for the indicator has increased greatly over the last month and has increased tremendously over last year. For the first six months of 1940 traffic stood at 453,278,195, revenue passenger miles —up 75.9 per cent.

See Finance page for individual companies' traffic figures.

STARRETT TOOLS *for* AIRCRAFT SHOPS

Aircraft technicians find that the 6-inch-deep U-cut frame of Starrett Micrometer No. 222 makes it extremely useful in aircraft shops. This Starrett Micrometer is only one of many fine Starrett Tools that are either especially designed for or particularly well adapted to the needs of the aircraft industry. Their clean-cut, easy reading graduations, their absolute accuracy, their efficiency and convenience make it safe to rush precision work.

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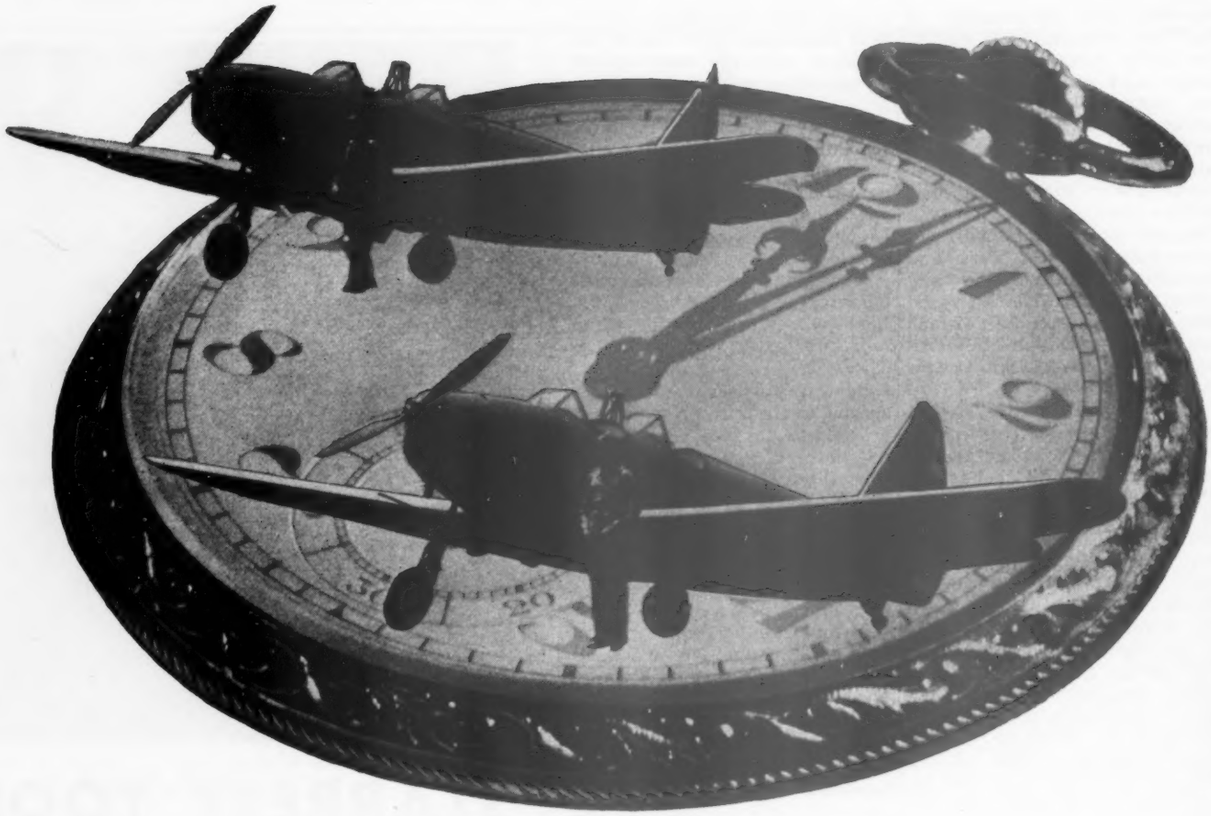

Every day...two MORE Fairchild Trainers

Fairchild Aircraft is now producing two M-62 Trainers for the U. S. Army Air Corps every day. Every production executive, every engineer, every man in this organization fully senses the importance of his efforts in meeting the pressing emergency of national defense. Before many months, this accelerated tempo of production, duplicated in all other efficient divisions of the aircraft industry, will result in an air force second to none in competency of its man-power and quality of its materiel.

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How to pick a perfect set of teeth

THIS Ranger expert can't tell you much about your new set of store-teeth, but he's a demon when it comes to judging the precision and quality of *gear* teeth. Making use of the most scientific equipment available to modern industry for the testing of gears, he can check concentricity as well as backlash to .0005 of an inch! Every tooth in every gear used in every Ranger engine is subject to this rigid inspection. No bad tooth can escape the microscopic eye of this instrument, and accordingly no bad gear can possibly make its way into the assembly of a Ranger engine.

For, in addition to the thorough and varied inspection of all gears and other forgings after fabrication, Ranger maintains complete control over the quality of these parts *during* fabrication. Before any lot of forged parts is released for final machining, the maker must first satisfy Ranger that every Ranger specification has been met!

Because Ranger takes nothing for granted about quality and precision, pilots in all branches of civil and service aviation have learned to place complete confidence in the dependability of its products.

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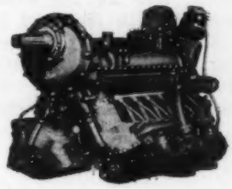

AVIATION FINANCE

Piper Aircraft is constructing three additions to present plant facilities which will increase plane-making capacity 50 percent. The company has a backlog of over 1,000 planes and is turning out 75 to 80 units a week.

Taylorcraft Aviation plans a public offering of 30,000 shares of 50¢ cumulative, convertible preferred stock to provide capital for additional plant and hangar space. This will permit a production increase to 2,000 planes a year, double present capacity.

Curtiss-Wright will complete in September a new propeller plant which will employ 1,500 skilled workmen. The new plant adjoins the Caldwell-Wright Airport at Caldwell, N. J. and its completion will more than double the company's propeller-making capacity.

Backlogs of the primary plane producers are more than keeping pace with accelerated deliveries. The following table gives the latest approximate unfilled orders of fourteen companies.

Aviation Corp.....	$5,000,000
Bell	22,000,000
Boeing	47,000,000
Brewster	44,000,000
Consolidated	97,000,000
Curtiss-Wright ...	200,000,000
Douglas	140,000,000
Grumman	9,000,000
Lockheed	140,000,000
Martin	110,000,000
North American...	84,000,000
Republic	15,000,000
United	200,000,000
Vultee	15,000,000

Vultee Aircraft will double existing manufacturing space at a cost of $2,900,000. Richard W. Millar, Vultee president, states that when the new floor area is completed the Downey, Calif. plant will have a total area of 802,000 sq. ft., an increase of 114 percent over the space now available.

The Glenn L. Martin Co. is proceeding on night and day shifts in order to reach maximum production on bombing planes for the British, and at the same time proceed with its part in the U. S. armament program, according to Glenn L. Martin, president. Approximately 12,000 persons, including more than 1,000 engineers are now employed at the Martin plant.

By Raymond Hoadley

Uncle Sam's defense program as it now stands is understood to call for $500,000,000 in aircraft plant expansion. Anticipating the increased demand for military planes, seven major West Coast aircraft producers will expand present manufacturing floor space by 70 per cent to a total of 8,200,000 sq. feet. Eight months ago the nation's entire aircraft-making capacity was only 6,000,000 sq.ft.

Harlow Aircraft has acquired a substantial interest in the Porterfield Aircraft Corp. of Kansas City, makers of light two-place cabin planes. This new association will give Harlow participation in small plane production and makes available extensive modern plant facilities for production on Harlow-type orders. Porterfield recently had 80 planes on order and planned to step up output to ten a week this summer.

Earnings statements of the major aircraft companies for the first half of 1940, almost without exception, will be the best for any similar period in their history. Sales for the first six months were collectively as large as the industry reported for all of 1939 ($225,000,000), and with output gaining each month, new high records in both sales and earnings are generally forecast for the current half year.

Annual report of Solar Aircraft Co., San Diego manufacturer of exhaust manifolds and other specialized aircraft parts, shows sales for the twelve months of $1,065,672. This is almost 100 percent greater than the previous best year, 1938-39, with $534,131. Net profit was $51,545, and is the eighth consecutive year in which the company has operated at a profit. Sales for the year were made to 54 individual customers, compared with 34 customers during the preceding period. More than 80 percent of sales were exhaust manifolds, with the balance consisting of cabin heater systems, cowling wells, and miscellaneous parts. Solar currently has 547 employees, a backlog slightly in excess of $1,000,000, a delivery rate of $30,000 per week, and an expansion program which is adding about 50 percent to factory floor space and production facilities within the 60 days ending Sept. 1. The appointment of Thomas H. Joyce and Jack L. Oatman as directors of Solar Aircraft Co. was also announced by Price.

Harvill Aircraft Die Casting Corp. is rushing a new 60,000 sq. ft. factory to completion on a site adjoining Los Angeles Airport, at a cost of $131,000. Occupancy is expected by September 1st. This expansion move climaxes a growth from a small organization doing die casting, experimental and development work, to a firm now producing more than 14,000 die castings per day. Over $50,000 worth of new equipment will be installed in the plant in addition to present equipment valued at $150,000.

Lockheed Aircraft Corp., in the largest West Coast plant expansion so far announced, is building, in conjunction with its subsidiary, Vega Airplane Co., a $4,000,000 addition to its Burbank, Calif., factories. The program will add 1,067,000 square feet of manufacturing space, doubling the present figure, and, according to Robert E. Gross, Lockheed president, will enable plants to triple or quadruple airplane production.

Brewster Aeronautical Co., through the lease of the Ford Motor Company assembly plant in Long Island City, N. Y., has become the largest plane maker in the New York area and fifth largest in floor space in the United States. Minor assembly will be handled at the new plant.

North American Aviation has started construction on the first unit of another expansion program. Two turns of nine hours are operated at the Los Angeles plant with production records attaining new highs in both April and June. A 50¢ dividend was paid to stockholders on July 1, as compared with a 40¢ payment a year ago.

Early reports indicate that the air lines in June operated more than 100,000,000 revenue passenger miles for the first time in their history. Air travel for the first six months of 1940 was the heaviest on record, approximately 60 percent greater than in the similar 1939 period. Reflecting this increased revenue, aggregate earnings of the fifteen major air lines totaled around $2,000,000 for the first half of 1940, as against $500,000 in the same period last year. All but two or three companies were operating at a profit as the summer season of heavy traffic opened.

Eaton Mfg. Co. is expected to report earnings for the first half of 1940 as a result of increased business in airplane engine parts and continued favorable sales of automobile parts.

With the Airlines

Company	Revenue Passenger Miles* June 1940	June 1939	% Gain	6 Months 1940	6 Months 1939	% Gain	Revenue Passengers June 1940	June 1939	% Gain	6 Months 1940	6 Months 1939	% Gain
Braniff.....	3,076	1,626	89	16,622	8,455	92	9,792	5,032	95	50,142	26,660	88
Chgo. & Southern...	1,725	829	51	6,516	3,949	65	....	....	....	16,791	9,901	69
Eastern.....	12,069	7,512	61	78,809	50,051	57	28,974	19,240	52	156,228	105,231	48
Northwest.....	....	....	....	....	....	....	11,773	8,304	41	.....	....	..
Penna. Central.....	4 012	2,068	94	15,815	9,064	74	21,713	11,628	87	87,864	51,750	70
T.W.A.....	14,882	9,900	50	.....	.....	....	....	....	....	.....	.....	..
United.....	24,335	15,180	60	93,682	58,339	38	....	....	....	.....	.....	..
Western Air.....	1,504	980	53	6,625	4,162	59	....	....	....	.....	.....	..

* (000 omitted)—current figures subject to final adjustment.

FASTER, VIBRATION-PROOF ASSEMBLY

The greatest need in the aircraft program is Speed! And the fastest method on 1940 assembly lines is the SPEED NUT System.

SPEED NUTS also afford a vibration-proof assembly with a double-locking spring tension grip that holds forever tight. One feather-weight SPEED NUT generally takes the place of two or more parts.

SPEED NUTS are manufactured of spring steel properly heat treated. Made in over 500 shapes and sizes, for most standard sizes of machine screws, sheet metal screws, rivets, metal and plastic studs.

May we ask for full details on *your* assembly problem? Samples and engineering data will be forwarded immediately.

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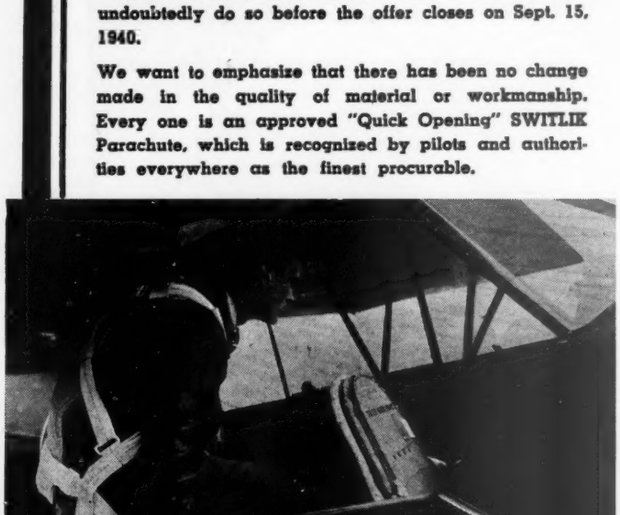
—and in cooperation with the C.A.A., we are making it possible for C.A.A. Operators to obtain Switlik Approved Parachutes at substantial reduction in prices.

50% of the C.A.A. Operators immediately took advantage of this price reduction, and many others will undoubtedly do so before the offer closes on Sept. 15, 1940.

We want to emphasize that there has been no change made in the quality of material or workmanship. Every one is an approved "Quick Opening" SWITLIK Parachute, which is recognized by pilots and authorities everywhere as the finest procurable.



The Quick Attachable model displayed above, enables the pilot and instructor to board a plane unhampered by a parachute.

The parachute as shown in the plane, is not of the cumbersome type, it permits the instructor and the pilot to do their respective work without bulky equipment, and yet the process of attaching the harness to the chute, when seated in the plane, is only a matter of a few seconds.

The Quick Attachable Parachute remains as part of the equipment of the plane. As the students are changed, only the harness has to be adjusted. This time saving, convenient feature is important in speeding up student training.

SWITLIK
SAFETY CHUTE
"The World's Fastest Opening Parachute"

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WEST COAST DISTRIBUTOR:
AIRCRAFT INDUSTRIES, CORP., GLENDALE, CALIF.

Packard Motor Co. is about to enter upon the manufacture of aircraft engines, having accepted an offer to make 3,000 Rolls Royce airplane motors for the United States Government and 6,000 for Great Britain. Both the Ford and Chrysler companies had previously declined to take the order. The RFC lending agency is expected to advance Packard the $30,000,000 required for plant expansion to carry out the contract. Packard plans to have a plant tooled for production in about ten months, starting at the rate of twenty engines a month and reaching 840 a month at the end of fifteen months.

American Airlines has arranged a 5 year-$2,250,000 loan with a group of banks, the proceeds to supply 75 percent of the purchase price of twenty-six Douglas transports.

Unfilled orders of Menasco Manufacturing Company have reached a new high figure of $2,492,636 as of June 30th according to A. E. Shelton, president. This represents an increase of $750,000 in a thirty day period, the bulk of the new business consisting of orders for the new Menasco D-4 125 h.p. trainer engine and spare parts for the Canadian government. Included in the total backlog is $1,482,770 for sub-contract machine work for other aircraft companies. Delivery on the Canadian order is to start in August and will reach a rate of 25 engines per month maximum in October, by which time the company will be located in its new Burbank factory. The new plant is being tooled for a production of four engines per day.

The fact that the Civil Aeronautics Board has granted you the right to run an air service over a particular route isn't worth money to you. At least that's what the Board decided when it turned down Transcontinental and Western's application to buy out Marquette Airlines. Marquette flies a 566-mile route covering the Detroit-Toledo-Dayton-Cincinnati-St. Louis sector, and TWA wanted the route $350,000 worth.

CAB agreed that the area rated better service than Marquette could provide, and that TWA would provide. But Marquette's equipment admittedly isn't worth much over $30,000, and it seemed obvious TWA was really buying a certificate of convenience and necessity. This kind of deal is not in the public interest, CAB thought.

Backlog of Aircraft Accessories Corp., Glendale, Calif., hydraulic parts manufacturer, has increased to $653,000 and number of employees to 209, according to announcement of Ted Lynn, president. The increase in backlog has occurred despite a recent 20 percent increase in delivery rate. Application to list 108,500 additional shares of its 50-cent par value Class A capital stock by Aircraft Accessories Corp., has been approved by the Los Angeles Stock Exchange. The additional stock will be offered to stockholders by means of transferable rights at the rate of one share for $2 to each two shares of Class A or B stock held as of July 24, 1940. Proceeds from the sale of the additional stock will be used in plant expansion and the purchase of additional machinery.

Here and There . . . *Grumman* booked $4,600,000 in new business in the June quarter while deliveries totaled $1,317,000 . . . Col. Roger Williams, transatlantic flyer, has formed the *Williams Aircraft Corp.*; will build a plant at Toledo and already has contracts to make airplane parts . . . *Taylorcraft* produced 254 planes in the first five months of 1940 . . . *Northrup Aircraft* has facilities for building fifty single-seat planes a month at its Hawthorne, Calif., plant . . . Recent *Canadian Colonial Airways* 60,000 share stock offering was oversubscribed . . . *Wright Aeronautical* has purchased thirty city lots adjoining its Paterson, N. J. factory . . . *Chicago & Southern Air Lines* has issued 45,000 shares of common stock for sale at $7.50 a share through a New York banking syndicate . . . To meet increased aircraft production orders, *Edo Aircraft Corp.*, is planning a $125,000 addition to its Long Island plant . . . Howard Hughes, through Hughes Tool Co., has acquired 153,700 shares of *TWA*, bringing his holdings to 325,000 shares or almost 35 per cent of the total stock outstanding . . . Payrolls of *Douglas Aircraft* up through May of this year were above $10,000,000, as compared with $14,290,000 in all of 1939 . . . *Curtiss-Wright* is reported turning out five fighting planes a day . . . June sales of *Beech Aircraft* totaled $364,000 while orders on hand will absorb present production facilities for a whole year . . . *Fairchild Aviation* will pay a 25¢ dividend on August 9 to stock of record July 26 . . . *Aero Supply Mfg. Co.* paid a 25¢ dividend on July 15 . . . *Luscombe Airplane Corp.* recently turned out 25 planes in one working week.

AVIATION OPERATORS CORNER

Each year the Aviation Country Club at Hicksville, Long Island, succeeds in proving that it is possible to put on an air show without races, hair raising stunt flying, or death-defying delayed parachute drops, yet still attract public interest. This year, according to Roger Wolfe Kahn who managed the show, there were about twice as many present as were expected. And yet, the crowd was well handled and everybody had a good time.

The show started with demonstrations of the various airplanes showing take-offs, climb, slow flight, landings, etc. Sperry's Lockheed flying laboratory and United's flight research Boeing 247 were on display. TWA had a Skysleeper open for the public to inspect.

One of the highpoints was a demonstration by Al Bennett of landing a Cub with one wheel off. After the landing, just to show how easy it really was, he took off and landed again with the wheel still missing. He made it look so simple that one began to wonder why they build airplanes with two wheels on the landing gear!

Finally, there were flights for those present in the various airplanes. TWA acted as host for anyone wanting a flight in the Skysleeper with the children having the first turns. From the way the kids climbed aboard there could be no doubt that the younger generation is travel minded.

Congratulations to Aviation Country Club, and may more shows follow its example and send their spectators home feeling that aviation has really outgrown the circus stage, and that they themselves want to fly.

Wisconsin's 1940 air tour takes off August 11 from Racine, under Generalissimo James B. King, NAA vice-governor. 50 ships and 125 pilots and passengers plan to visit Kenosha, Janesville, Madison, Lake Delton, LaCrosse, Rice Lake, Medford, Wausau, Stevens Point, Wisconsin Rapids, Shawano, Clintonville, Sturgeon Bay, Green Bay, Oshkosh, Waupun, and wind up August 17 at Milwaukee. With entertainment, dinners, and lay-overs furnished by aero clubs and civic groups en route, each participant gets a week of aero-fun. At Milwaukee, the aeronauts guestar for the state fair, August 17, as Wisconsin observes its annual "Aviation and Defense Day." Gov. Julius P. Heil of Wisconsin proclaimed the date in recognition of the state's aero activity.

California pilots swept the Southwestern Soaring Championship meet at Wichita Falls, Texas, held in June. John Robinson of San Diego took first place with his Ross-Stephens sailplane; Dick Essery, also of San Diego, took second place with his sensational new two place trainer; and Harlan Ross, of Glendale, Calif., placed third with the Bowlus Super-Albatross. Robinson also set two new meet altitude records, exceeding 11,000 ft. on both flights. Randy Chapman, of Detroit, made the best single distance flight, covering 176 miles in his L. I. T. sailplane.

The city of Mobile, Ala., has purchased a 591 acre tract of land on which it will erect a new airport. The city sold its old airport, Bates Field, to the government for $133,000 to make way for the establishment of an $8,000,000 army air depot on the site. The new airport site is located 12 miles from the city.

An emergency landing field 2,000 ft. long, and 150 ft. wide, is being constructed on Mullet Key, a small island midway between St. Petersburg, Fla., and Bradenton, Fla., in Tampa Bay. Since Pinellas County purchased this island from the U.S. Government recently, the St. Petersburg Aviation club has been agitating for establishment of a landing field there, to make the flight across the bay safer for the growing number of light planes in this area. The county highway department is grading and leveling the site. St. Petersburg fliers plan a massed flight by light ships to the field for a summer outing and picnic, when it is completed. All Florida small ship pilots are to be invited.

Twelve business and professional men of Olathe, county seat of Johnson County, Kansas, have pooled their assets and purchased a two-place Piper Cub. A pasture near town has been leased for the airport and a hangar constructed. Thomas Weber of Clinton, Missouri, is flying instructor and will also act as director of the club. Olathe is near Kansas City.

Of the initial $50 individual membership fee, $31.70 went toward the purchase of the plane and the remainder was used for the erection of the hangar. A $6 monthly fee will be assessed each member. The flying club is the first of its kind in this section of the country.

After a month in its new location at Municipal Airport, the Kansas City Flying Service is doing a capacity business in flying instruction. Government approved for flight instruction by the local CAA office, the school is now awaiting official approval from Washington. Fifty commercial students are enrolled here in addition to 45 CAB beginners under the summer emergency expansion program. The latter will qualify for private licenses September 1.

The Kansas City Flying Service claims the distinction of soloing the first CAA student in the Kansas City district. The date was Monday, July 1, and the student, Roger Boggs, soloed after eight hours of instruction.

Instructors are Edgar F. Smith (who is also one of the operators of the flying service company); Jess Blevans, and Winthrop (Wink) Cantrell. Mr. Cantrell, incidentally, is said to be one of the youngest commercial pilots and rerated instructors in the Middlewest. He is nineteen and has been flying over a year. He is a law student at the University of Kansas City.

The school has three Porterfields and has back-ordered two more, in addition to one each of the following make planes: Cub, Fleet, Aeronca, Stinson, Waco and Travelair.

New Minneapolis Administration Building.

Pittsburgh, So far lack of $3250 in private funds prevents more than ten of a class of 100 young men and women enrolled in a ground course, from receiving actual flight training in the government's subsidized airplane pilot training program.

If both the Aero Club of Pittsburgh and the Junior Chamber of Commerce, sponsors in Pittsburgh, will finance ten students apiece, the CAB will finance ten students.

Taking a lesson from the aircraft factories to which it furnishes trained personnel to meet the present emergency, the Ryan School of Aeronautics has announced a two-shift schedule for a portion of its mechanics training school. With day-time classes in the sheet metal and riveting departments of the school already turning out more than 50 production mechanics each five weeks, Earl D. Prudden has placed these departments on a schedule calling for day classes from 8 a. m. to 5 p. m., and night classes from 6:30 to 10:30 p. m. And speaking of training, the Ryan Aeronautical Company reports that eighteen flying schools are now giving primary and advanced flight training in the Ryan S-T low wing all-metal monoplane such as has been adopted by the Army Air Corps for primary training.

Pittsburgh, The State Department of Public Instruction, opening vocational schools for industrial defense training in 19 Western-Pennsylvania counties under the direction of Andrew Treche and Charles F. Hoffmaster, for courses in aircraft and drafting, has all Pittsburgh courses operating.

The directors anticipate enrollment to run between 3,000 and 5,000 men. Some WPA enrolees will draw pay only while taking the free training.

TRAINING

In line with the vastly greater demand for aeronautical training which has resulted from the present national defense emergency, the Westwood School of Aeronautics, of Inglewood, Calif., announces new correspondence courses of a type planned to speed development of both engineers and aircraft workers. Said to be the most complete basic training of its type ever offered, the major new course is titled "The Airplane, Its Construction and Operation", and covers 28 assignments under such general headings as: Types of construction, wings, control surfaces, landing gears, aircraft engines, propellers, etc. The course is in addition to the school's engineering courses, for which record enrollments are reported by Gordon D. Brown, president.

With the Army Air Corps expanding primary pilot training to meet the present emergency, Ryan School of Aeronautics is undertaking a five-fold increase in training activities. In place of the usual class of 35 new cadets each six weeks, Ryan is enrolling 95 cadets on August 3rd in addition to 70 cadets at the new Ryan branch school. To accomodate the enlarged number of flying cadets at the San Diego school, the cadet barracks are being enlarged to accomodate 128 men instead of 72, as at present. An investment of approximately $25,000 is being made in fourteen additional housing units. Many additional flight instructors, ground instructors, and mechanics, are being added to the Ryan staff.

The aeronautics course of Modesto Junior College, Modesto, Cal., has attracted more than 200 students this year. The aviation division of the school was started in 1937 and has grown from 33 students to the full capacity that the school can take care of. Karl M. Roth is the instructor and has put great emphasis on making the training as practical as possible. The general layout of the shop and the method of instruction follows factory work as closely as possible. During the four-semester course students take many field trips to nearby factories and airports. Students receive a total of 1,200 hours of instruction before they graduate.

Fifty-five additional students have just enrolled in the Luscombe School of Aeronautics. In order to properly accommodate these students the Luscombe organization has taken a lease on 10,000 sq. ft. of space in Trenton.

This space has been equipped with four aircraft sheet metal construction devices for the making of airplanes. The equipment provides a shop with individual space for students to work, also shop, drafting and lecture rooms.

The reason for the expansion on the part of the Luscombe organization is to cooperate in the general program for national defense.

When the students are turned out they will be placed with military and civil aircraft manufacturers. Day and night courses are given in the school.

Two new Kansas City aeronautical schools opened Monday, July 1, in neighboring buildings on McGee Trafficway in Kansas City.

The National School of Aeronautics is headed by A. A. Price with TWA staff members as associates. The three-story building at the northwest corner of 26th and McGee has been leased for the school.

The American Aeronautical Institute is under the supervision of V. D. Vale who formerly directed another mechanical training school. The location is 2425-31 McGee. Twenty-five students were enrolled opening day and facilities are planned to accommodate 250.

Associated with Price in the National School of Aeronautics is Russell J. Dick, TWA pilot and vice-president; also John Vale and James Heaston, both with the transport line. A state charter for $100,000 capital, of which $30,000 has been subscribed, has been obtained. Arrangements are being completed to accommodate 500 students.

Both schools will specialize in the training of mechanics and both are applying for certificates from the CAB.

A corner of one classroom at Modesto Junior College. Metal tool boxes shown in the foreground are made by students. In the left background are two metal boats which are also made by students. This gives them practice in layout and all other phases of aluminum sheet metal work.

How they do it in the movies. A scene from Warner Bros. new film, "Young America Flies" which deals with the Civilian Flight Training Plan. It will interest all aviation schools.

Organization of a streamlined engineering course, to convert men with general engineering background to the specialized field of aviation, has been announced by the California Institute of Technology, in collaboration with Lockheed Aircraft Corp. This plan is a long step towards meeting the great need for trained engineers in our present military emergency. Robert E. Gross, president of Lockheed Aircraft Corp., has pointed out that increased numbers of qualified aircraft engineers are needed to design advanced type military planes, and to plan for their production with maximum speed and efficiency. It is reported that Germany now has 50,000 trained aircraft engineers, as contrasted with about 10,000 in the United States. The first class under the new Cal-Tech plan will number between 100 and 200 men and is now in process of formation. Lockheed is assembling these engineers from all parts of the country. The training program will consist of eight weeks at the Institute and then eight weeks of training at the Lockheed factory. Expenses and salary will be paid to men selected, and employment at the Lockheed factory is guaranteed upon satisfactory completion of the course. Dr. Robert Millikan, president of Cal-Tech, has offered a similar arrangement to other California aircraft manufacturers.

Southern California pilot training schools continue to expand bumptiously. Cal-Aero moved in both directions by opening a branch school 40 miles northwest of Los Angeles at Oxnard, for training groups of about 90 cadets, and going to work on a $250,000 flying school plant at Ontario, about fifty miles east of Los Angeles. The Ontario school program ran into labor difficulties right from the start, and as this is written new forms of trouble are still making the newspapers, thus posing another problem for our national defense problem. Obviously we cannot hope to achieve an adequate defense without the full support and cooperation of labor. Erection of cadet barracks at Ontario has been seriously hampered by a strike of carpenters against the contractor in charge of construction. In addition to normal picketing activities it is reported that many strike breaking workers have had the tires on their cars punctured, and a slight amount of malicious damage has been reported done to the building supplies on the ground.

the ERCOUPE begins a new Era in Private Flying

● **A NEW ORDER OF EASE AND SIMPLICITY OF FLIGHT IS ACHIEVED BY REDUCING CONTROL PROBLEMS TO A MINIMUM**

● **ERCOUPE'S INDIVIDUAL CHARACTERISTICS INVITE CROSS-COUNTRY FLYING AND GIVE CONFIDENCE AND PEACE OF MIND**

● **UTILITY IS FURTHER INCREASED BY A CRUISING SPEED OF OVER 100 M.P.H. AND THE ABILITY TO USE ANY SMALL FIELD**

● **OTHER ERCOUPE FEATURES INCLUDE:**

Excellent all-round field of view, both in the air and on the ground, through transparent convertible coupe top.

Can be changed in an instant from an open to a closed airplane.

Elimination of spin hazard. (Certified SPINPROOF by the Civil Aeronautics Board.)

Tricycle landing gear and hydraulic brakes which make for easy landings, short runs, and eliminate danger of ground-looping or nose-overs.

Steerable nose wheel for positive ground maneuvering.

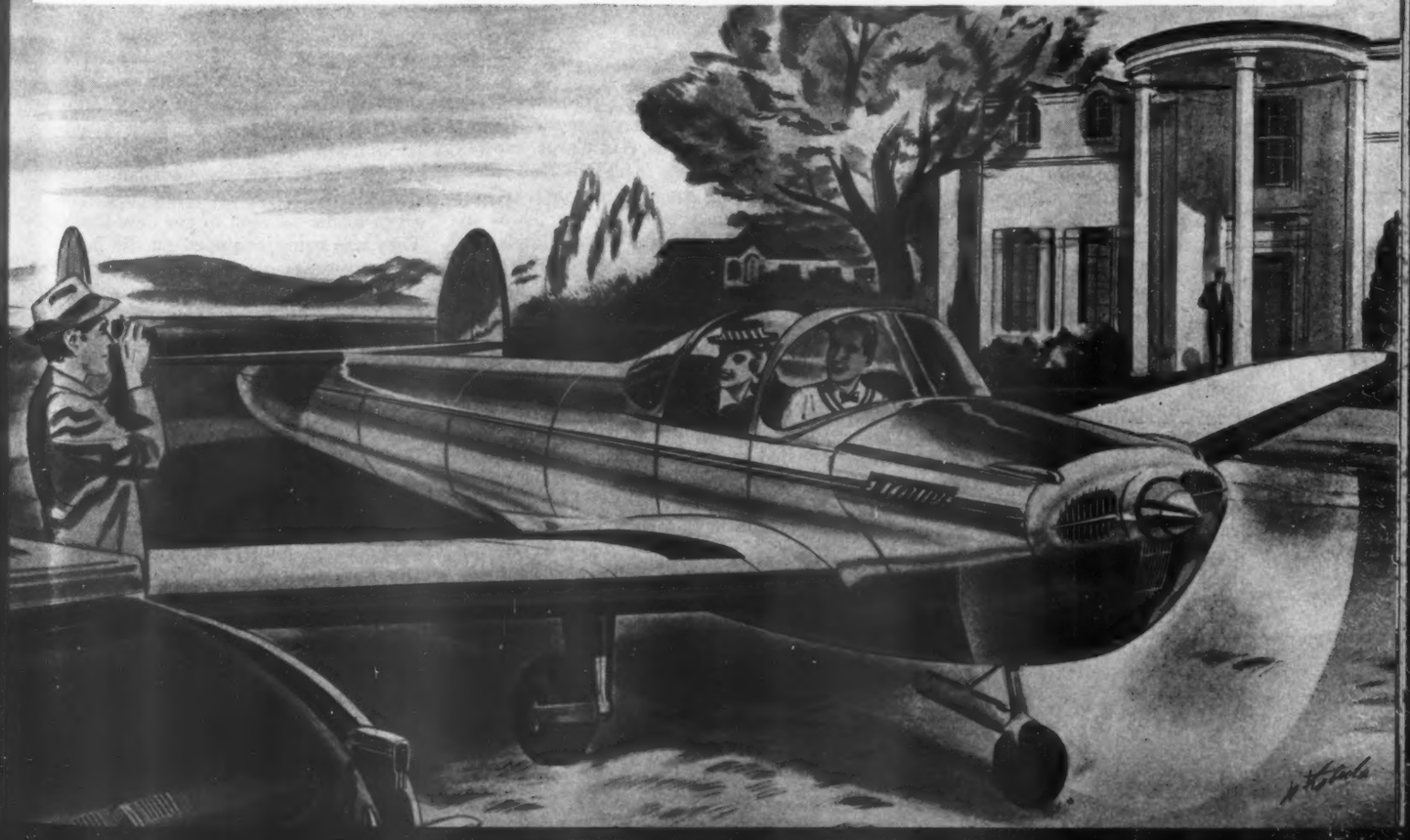
Ability to operate under high wind conditions.

Economy of maintenance and durability from all-metal construction.

● **These are features that make The ERCOUPE an essentially useful airplane for your personal transportation. We will gladly give you full particulars.**

Two-place—65 h.p. Continental Engine—$2590 f.a.f.

PERFORMANCE WITH SAFETY **ERCOUPE** *ENGINEERING AND RESEARCH CORPORATION*
RIVERDALE, MARYLAND · CABLE "ERCO-WASHINGTON" D.C.



Air Corps Training

(*Continued from page 41*)

During his 35 weeks of instruction, a pilot has received his first instruction in the small, slow primary trainers. The second stage is in the faster, heavier basic trainers. The third stage is given in advanced training planes. He is now ready for the final step up to the modern airplanes now being delivered. This step is given in several fields for specialized training. The pursuit training field will be at Selma, Ala., with a gunnery base at Eglin Field, Fla. Bombardment Schools will be located at Ellington Field, near Houston, and at Barksdale Field, near Shreveport.

A pilot does not get all his training in the air. In his 35 weeks of instruction he has spent at least 290 hours in ground classes in the following instruction: tactical orientation, military training, indoctrination and familiarization, airplane and engine maintenance, signal communications, armament, instruments, Link trainer, meteorology, navigation, chemical warfare.

After he is assigned to a squadron, a pilot continues his training, whether it is pursuit, bombardment or reconnaisance. He flies about 250 hours a year, which is divided according to the type of squadron he is with. All pilots must do about 10 percent of their flying at night, with a specified amount of cross-country, formation, high altitude and instrument flying.

Bombardiers and Navigators

We are now preparing to train some 1,200 bombardiers and navigators annually. Modern fighting has shown the need for additional crew members who are thoroughly trained as part of the combat force. Skillful bombardiers and dependable aerial navigators cannot be turned out over night. They must go through an extended period of training.

It is probable that some of these men will be drawn from the ranks of flying cadets. As men go through their flight training, a certain number are not graduated from one stage to the next. While some of these men do not meet the Army's high standards for pilots, they have the qualifications for excellent bombardiers or navigators. They are far too valuable to be sent home, and many will be given an opportunity to qualify in the Air Corps in our combat crews.

Civilian Pilot Training

We are receiving many inquiries these days as to the relationship between the training program offered by the Civil Aeronautics Board and that of the Air Corps. General Arnold representing the Air Corps, and Admiral Towers representing the Bureau of Aeronautics, had numerous conferences with Mr. Hinckley while the C.P.T. program was being set up. We have watched its progress for the past year. The Air Corps believes it is doing a valuable service in making America air minded and in providing a reservoir of pilot material.

There is no implied promise that the Air Corps will accept any of these young men for its pilot training program. Nor, on the other hand, does the C.P.T. student make any promises that he will apply for our service. But from our study of the type of young men now learning to fly in colleges throughout the country we believe that many of them have the physical and mental qualifications that we are looking for in our flying cadets. The Air Corps hopes that it will receive many applications from such young men.

The United States has the greatest reservoir of potential pilots in the world. Our American method of living, with its emphasis on good health, out-door activity and independent thinking has developed a generation of healthy, well-coordinated young men. We find them in every corner of the country. Because of their numbers and their patriotism, there is no thought or need of lowering our standards.

Training for Mechanics

Although the pilot training program has received most of the newspaper publicity, the Air Corps knows that its training program for mechanics is of equal importance. Our airplanes must be ready to fly at a moment's notice, and in all kinds of climates and weather. As any pilot will testify, Air Corps mechanics make up one of the most important elements in our flying teams.

Formerly mechanics' training was given at Chanute Field, Lowry Field, the Air Corps depots, or in the squadrons. During the past year we have enlisted in the Air Corps about 25,000 additional men who are now learning to be mechanics and technicians. This expansion has brought a need for new training methods.

In addition to enlarging facilities at Chanute Field, and Lowry Field, we have established a training school at Scott Field, Ill. Even these enlargements were not sufficient, and Air Corps has been using the facilities of seven privately-owned aviation schools since July 1, 1939, and other schools will soon be added.

The Navy Expands

(*Continued from page 39*)

New Bases

Planes and personnel do not complete an aircraft program. Properly equipped and properly located air bases are a vital part in our program. In addition to improving all existing Naval air stations, funds have been voted for building the balance of the stations recommended by the Hepburn Board, with the one exception of the station at Guam.

When this development program has been completed, the Bureau of Aeronautics will have facilities at Norfolk, Va.; San Juan, P. R.; Coco Solo, Canal Zone; Seattle, Wash.; Kodiak, Alaska; Unalaska, Alaska; Pearl Harbor, T. H.; San Diego, Calif.; Midway Island; Wake Island; Johnson Island; Quonsett Point, R. I.; Quantico, Va.; Quantanamo, Cuba; Charlotte Amalie, V. I.; Alameda, Calif.; Tongue Point, Ore.; Key West, Fla.; Cape May, N. J.; Lakehurst, N. J.; Sitka, Alaska.

The study of a map on which these 21 bases are plotted shows how strategically they are located. Beginning with the three Alaskan bases, the Navy will have facilities at four other points on our West Coast, a base at the Canal Zone, and other stations situated in the islands off our Southeast Coast, and along the East Coast. In addition, we have strong positions on several of our Pacific islands.

A great deal of attention has been given to the location of the new bases. They are being equipped on the basis of many years of experience in naval aircraft operation. The bases will be furnished with types of airplanes best suited to the individual needs of the location. As funds for a substantial number of long-range patrol bombers are now approved, it is expected that this valuable addition to the fleet will be a part of the planes furnished to each station.

With the finest kind of planes available, and with a large force of well-trained pilots and enlisted men, the Bureau of Aeronautics feels confident that it can do its share in national defense.

THE VALIANTS GO INTO THE BLUE...

Each day sees more and more Vultee Valiant Basic Trainers rolling off the production line and on the way to their work in the sky. Built for the United States Army Air Corps and designated the model BT-13, these airplanes are used in training pilots for our nation's air force. Like the Vanguard Pursuits, V-12 Attack Bombers and other Vultee military airplanes, the Valiants are a product of a carefully planned straight-line production system. With a new expansion program already well under way, the Vultee organization is working at full capacity to help meet our country's national defense requirements.

VANGUARD

VALIANT

V-12

Vultee

VULTEE AIRCRAFT, INC.

VULTEE FIELD, CALIFORNIA, U.S.A. CABLE ADDRESS, "VULTEE"

Sub-Contracting

(*Continued from page 51*)

their employ sufficient skilled workers (die and tool makers, expert machinists, etc.) to care for a larger number of machine operators or bench workers than currently employed. In such cases, the increase in output incident to taking on aircraft work requires the employment of semi-skilled types rather than the highly skilled men where the greatest shortages exist.

A similar investigation of idle plant facilities is included. It brings to light vacant floor space or buildings and uncovers the manufacturers willingness to expand by the establishment of a new department to produce aviation material. Often, manufacturing companies are seeking new products of sufficient promise to justify the re-equipment of unused space. Where the character of raw material processed, the labor employed, and the product made indicate the probability that the manufacturer can successfully produce some aviation part or accessory, he should be encouraged to so utilize his plant facilities.

Throughout the collection of this information, the staff of the Connecticut Commission was impressed with the importance of encouraging only those manufacturing concerns to enter the making of aviation material which were fundamentally suited to doing so successfully. In the case of each Connecticut manufacturer with whom the Commission made contact, the utmost honesty was exercised by the Commission staff in forming an opinion as to what the manufacturer might do for the aviation industry satisfactorily. In addition, each manufacturer was told that the aircraft industry would have to invest a substantial amount of time and effort in teaching his personnel aviation's particular requirements of precision and care. It was emphasized that he should not undertake the production of aviation material unless he was prepared to include it as a permanent part of his company's activities.

It is this conception of the relationship between aviation manufacturers and industrial concerns who must supply their requirements that has differentiated the work of the Connecticut Aeronautical Development Commission from the usual local trade association efforts to promote new business for its members.

The procedures of the Connecticut Commission were carefully checked with the Army Air Corps, with representatives of the Aeronautical Chamber of Commerce and of the aircraft industry. Since the latter part of May the procedures and forms used in Connecticut have been adopted by Massachusetts and Rhode Island, and it is reported that the Air Corps has called these methods to the attention of other state associations or commissions.

Today Connecticut is prepared to aid the air defense program fully, due to the foresight of its Governor. Its manufacturers are largely awake to the opportunities and necessities of coordination with aviation. Its industrial resources are being carefully analyzed and inventoried against the expected increase in demands for voluntary cooperation from aviation. Available are the services of the Manufacturers Association of Connecticut, the Connecticut Chamber of Commerce and the Connecticut Development Commission, in addition to the Connecticut Aeronautical Development Commission comprised of men with practical experience in aviation's problems.

The work of the Connecticut Aeronautical Development Commission has ceased to be a re-employment effort based on the closer coordination between Connecticut's diversified manufacturing plants and the growing aircraft industry. It has become a national asset in preparation for the largest military effort ever to be undertaken by the United States. It is a pattern which has been tried, which works and which is available to state or local bodies—who wish to apply these methods to our common problem of forwarding the national defense in a business-like manner.

C.A.A.

(*Continued from page 58*)

10 amended certificates have been issued and 6 have been denied. Cases still pending: 30.

Foreign permits: 9 applications have been filed, 2 have been issued and 7 are still pending.

Rate decisions: 27 filed, 12 acted on, 15 still pending.

Rates for carriage of persons and property: 2 filed, 1 acted on, 1 pending.

Non-stop service: 1 case filed and acted on.

Airport changes: 2 filed, 2 closed.

Interlocking relationships: 64 filed, 48 acted on; 16 pending.

Miscellaneous: 35 cases filed, 24 acted on, 11 pending.

Total number of cases which have actually been docketed: 401.

Total number closed: 149.

Total cases pending: 252.

Enforcement Section

The first report of the Enforcement Section was dated from March 1, 1939, to March 1, 1940, which was the first full-year period during which the current procedure was in use. During this time there were 1,124 violations reported and the number of actions taken was 846. Actions taken were less than the violations partly because a large number of violation reports contained numerous violations against one person. Yet only one action might be taken in such cases.

A total of 958 violations were received against pilots. Of these, student pilots had 196, solo pilots 107, private pilots 230, limited commercial pilots 48, commercial pilots 199, airline pilots 25, and uncertificated airmen 153. Private pilots had the most violations, but were followed by commercial, student and uncertificated.

Violations by other individuals than civilian pilots totaled 166, which break down as follows: mechanics 34, aircraft owners 97, parachute riggers 3, dispatchers 6, manufacturers 2, air carriers 12, repair stations 2, schools 6, army pilots 4.

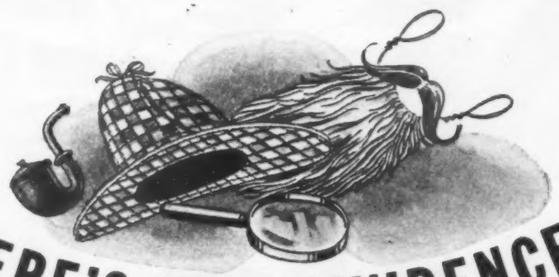
Of the 846 cases in which action was taken, 180 carried civil penalties.

In the four months subsequent to the above report, and ending June 30, 1940, the Enforcement Section received 249 violation reports and reviewed 347 cases.

Rolls-Royce Merlin

(*Continued from page 64*)

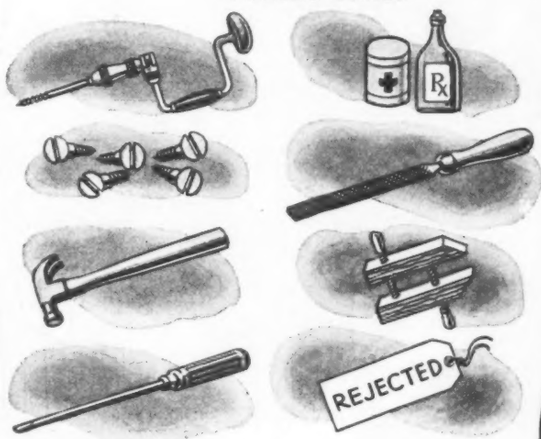
would have to employ 14,000 additional skilled craftsmen to build 9,000 Merlins by mass production methods. As it is improbable that these engines would begin to come off the assembly lines in any quantities much before 1942 and we would then have to take the last 3,000 of the 9,000 engines, the question arises: "Will present-day Rolls-Royce Merlins be sufficiently up-to-date when we get them for the high-performance warplanes required for our National Defense during the years 1942 to 1945?"



HERE'S YOUR EVIDENCE

WHY

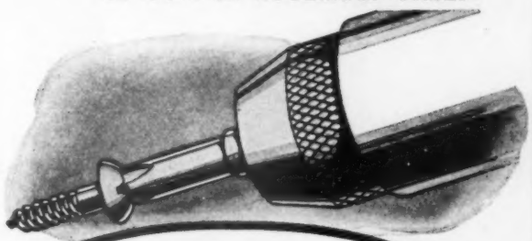
DRIVING OLD-FASHIONED SCREWS WASTES TIME.



Twice as many hands are needed with old-fashioned screw driving as with **PHILLIPS RECESSED HEAD SCREW** *shown at right.*

WHY

PHILLIPS SCREWS SAVE AN AVERAGE OF 50% IN ASSEMBLY TIME.



Every item pictured left represents unnecessarily wasted time — hours which *can* be saved using Phillips Screws.

Phillips Screws shorten hours spent in screw driving, and speed delivery of your products by eliminating:

need for drilling pilot holes
need for a helper to steady the work
slow driving with hand drivers
crooked screws or split heads
accidents caused by slipping drivers
delays caused by broken drivers
refinishing screw driver scars

The Phillips Screw clings to the driver, permitting one-hand driving while the other hand holds the work. The recess prevents the driver from slipping, so it's safe to use a faster driving method. Fewer screws (or smaller, lower-cost sizes) can be used because the Phillips Screw provides greater holding power.

The reason you see Phillips Screws on most makes of cars, aircraft, electrical appliances, furniture, etc. — is that those manufacturers have proved it costs less — in time and money — to use Phillips Screws. Don't let slow-poke fastening cause an unnecessary jam of unfilled orders. Get in touch with one of the firms listed below.

PHILLIPS RECESSED HEAD SCREWS...

MACHINE SCREWS · SHEET METAL SCREWS · WOOD SCREWS · STOVE BOLTS

Speed Product Deliveries by Cutting Assembly Time

U. S. Patents on Product and Methods Nos. 2,046,343; 2,046,837; 2,046,839; 2,046,840; 2,082,085; 2,084,078; 2,084,079; 2,090,338. Other Domestic and Foreign Patents Allowed and Pending.

American Screw Co., Licensee, Providence, R.I.
Continental Screw Co., New Bedford, Mass.
Corbin Screw Corporation, New Britain, Conn.
The Lamson & Sessions Co., Cleveland, Ohio
National Screw & Mfg. Co., Cleveland, Ohio
Parker-Kalon Corporation, New York, N.Y.
Pheoll Manufacturing Company, Chicago, Illinois
Russell, Burdsall & Ward Bolt & Nut Co., Port Chester, N.Y.
Scovill Manufacturing Co., Waterbury, Conn.
Shakeproof Lock Washer Co., Chicago, Ill.

Now a

Perfected AUTOMATIC RADIO COMPASS

By Bendix—the name that symbolizes dependability in Aviation Radio . . . Since 1938, Bendix has delivered over 2600 visual indicating radio compasses to satisfied customers throughout the world—customers who today are the best Bendix salesmen. To these time-tested designs Bendix now adds automatic direction finding—continuous visual indication of accurate unidirectional bearings. Silent and dependable, thoroughly engineered—rigorously tested, the Bendix MN-31 Automatic Radio Compass ably upholds the enviable reputation of Bendix Radio in the field of Aviation. Available with frequency ranges to meet varied requirements. Detailed information available on request.

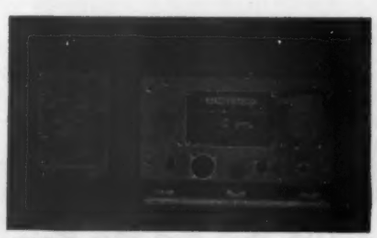
BENDIX RADIO CORPORATION

BALTIMORE, MARYLAND, U. S. A. CABLE ADDRESS: BENRAD

BENDIX—STANDARD FOR THE AVIATION INDUSTRY

CONTROL UNIT AND LOOP. The control unit provides the mechanism for automatic loop rotation including a rate change circuit which reduces the speed of loop rotation as the correct bearing is approached. The loop rotating motor and associated mechanism are completely integral in the loop base, which mounts flush with the skin of the airplane.

INSTANTANEOUS BEARINGS are read from the Bendix Direct Reading Azimuth Indicator, automatically corrected for quadrantal error. A movable scale can be set in accordance with the aircraft's magnetic, or true heading and is an aid to accurate and rapid navigation. Two Indicators can be employed simultaneously if desired.



BENDIX MN-26 RADIO COMPASS RECEIVER AND REMOTE CONTROL UNIT. Over two thousand Bendix Compass Receivers are in every day service throughout the world. Single or dual remote control. Electrical band change. Self-contained power supply.

Plant Location

(*Continued from page 55*)

fective bomb load depends on the distance of the target from the take-off points of the attackers. For this reason, a plant located in the geographical center of the United States would be ideal at the present time, if we envisage attacks only by aircraft launched from carriers. However, these attacks would be launched mainly for their moral effect, for there are not sufficient carriers in the world right now to carry out an effective and dangerous attack on the industrial life in any part of the United States. This can be readily seen from the fact that only about 40,000 lb. of bombs can be carried at one time by the airplanes from a carrier for an attack against a target only a short distance away. And, since carriers are particularly vulnerable to concentrated air attack themselves, they could not remain to launch more than one flight.

But what of the next ten years? We are told that it is even now technically feasible to build land-based planes capable of flying with bomb loads 4,000 miles to a target, and returning to their bases. It is conceivable that an economically powerful foreign nation or coalition might build a fleet of such planes for use against this country. Assuming such a possibility, what part of the United States would be safest from attack?

Since we must look at least ten years ahead, we cannot limit ourselves to possible sources of attack from Europe alone. We must assume the possibility of attack from bases established in Canada, South America, the Azores, Alaska, West Indies, and even Hawaii and Mexico.

Surprisingly enough, study of a map on which bombing distances are plotted indicates that areas in the central states are nearer several possible sources of attack than areas on the two sea coasts. Furthermore, Illinois is less than 4,000 miles from five logical sources of attack, while New England also is 4,000 miles or less from five logical sources of attack.

It is also pertinent to note that for the central states, the avenues of attack from Canada and South America are unguarded by any mountain ranges, the routes being along river valleys and low land.

From these considerations it would appear that location with respect to sources of attack is a relatively minor factor, there being the possibility that any area chosen at the present time as being particularly safe from attack, might soon prove to be particularly vulnerable.

Protection against invasion by ground forces is a problem of strategy somewhat similar to that of protection against invasion by air forces. Probable points of invasion are widely separated, and a location in the central states might be just as vulnerable from an invasion standpoint as a location in certain coastal states. If a powerful enemy force laid siege to the United States, final attacks would probably be made either from the north through the Great Lakes or from the south through the Mississippi River. The three invasions which history records were from Canada, New Orleans, and Chesapeake Bay. The latter attack was of a punitive nature and had no real strategic meaning.

A final step to take for local protection in case of serious threat of aerial attack at any particular location, would be to go under the ground. Bombproof shelters could provide adequate protection for personnel and vital machinery, without disrupting the industry by moving to a spot hundreds or thousands of miles away where safety might be only temporary. Not only would the actual cost of moving down under the ground be less than a long horizontal movement, but there would be far less danger of a serious lowering of productive capacity due to change in labor supply.

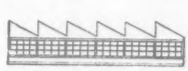
Of course, moving under the ground would be a measure taken only as a great national emergency approached, but it could be done on much shorter notice than could a move to a location a long way off, provided the plant site was suitable for excavation.

The two factors of II b and II c, isolation and concentration, are mutually antagonistic. Isolation implies separation of each productive facility in widely separated areas all over the United States. In this case, the enemy would have to disperse its forces in attacking each one of its targets, and would find difficulty in locating many of the targets due to lack of navigational skill on the part of many of the pilots. The opposite plan of concentrating a number of productive facilities together would enable easier location of the general target by the enemy, but at the same time would provide the defenders an opportunity to organize a properly effective. defense. Only where a dozen or more batteries may be organized in a concentrated defensive zone can an effective anti-aircraft fire be produced against enemy raiders. The same is true of protection by pursuit aviation; only when pursuit aviation can be organized in relatively large numbers can its full effectiveness be applied.

There is a parallel to the above dilemma of isolation versus concentration in the experience during the war in combatting the submarine campaign against merchant ships. It was not until 1917 that the proponents of the convoy system were heeded, after losses under the isolated ship system had reached staggering proportions. With the convoy system, whereby the protective power of the destroyers could be effectively employed, losses from submarine attack dropped to 30 percent of the losses under the isolated ship system.

The principle of the convoy system seems just as strong in protection of ground establishments from air attack. If important manufacturing plants were isolated here and there over the country, each one could have only slight anti-aircraft protection, and would be an easy target for attack. If, on the other hand, several important plants were gathered together under the guard of a coordinated anti-aircraft defense, air attack could be made only with danger of heavy losses to the attackers.

Location of a plant in a general industrial area does not necessarily mean in or near a very large city. There are a number of areas, comprising hundreds of square miles, in New England, Ohio, Illinois, New Jersey, New York and Pennsylvania,



in which there is a general distribution of manufacturing establishments in many towns and small cities located fairly near each other. In such an area, one obtains both the benefits of dispersion and concentration at the same time. A manufacturer may subcontract many of his parts requirements to small machine shops and foundries, within close enough distance to provide good technical cooperation, but separated enough to provide dispersion protection.

Such an industrial area also provides flexibility of labor supply. Especially in war time, any highly tech-

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Throughout a quarter of a century of progress in this industry, M-R-C has been a dominating factor.

Today, every important aircraft engine made in this country uses M-R-C bearings in the most vital positions.

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Factories at: JAMESTOWN, N. Y. and PLAINVILLE, CONN.

nical manufacturing plant would be continuously looking for men with special skills to solve special production problems. In an area with a sparse supply of various types of skilled labor, there would be serious delays in finding men to fill the special jobs.

Conclusion

From the above discussion, it is impossible to say that any specific location in the United States would be ideal from a strategic standpoint.

If this were a "totalitarian nation", the government might order the plant and all its trained and skilled salaried and wage personnel relocated immediately in Kansas, thus insuring against any prospect in the near future of harassment by planes launched from naval aircraft carriers. Then, if the location proved unsafe ten years from now due to establishment in Venezuela of a strong enemy air power possessing long-range heavy bombers, the plant might again be relocated in Oregon. Or, if Hawaii were occupied by an enemy coalition, the plant might be relocated in Pennsylvania, New York or New England.

The nation not being totalitarian, and the desirability of any general location likely to change with a changing international situation anyhow, the important factors in the location problem become those of local protection. In this respect, very large cities are definitely undesirable. The ideal situation would be a group of plants scattered over several square miles in a hilly forest, with the area heavily defended by anti-aircraft artillery and locally based pursuit squadrons.

Adequate water and power supply must always be kept in mind. Transportation facilities must be such that if power fails, or if one or two roads to a plant are blocked, workers will still be able to get to their jobs.

Since no location is ideal from a strategic standpoint, the problem of adequate labor supply to fit the individual needs of the plant in question is one of the most important to be considered.

When two or more locations have approximately the same supply of potential labor, and also meet the other factors listed above, distance from the parent plant may be the deciding factor. As a general rule, nearness to the home plant is an asset.

Procurement for Defense

(Continued from page 43)

of this character are New England, the metropolitan area adjacent to, and including New York City, Central East and the West Coast areas.

Another classification of labor, important particularly to the airframe manufacturer, are the learners. These are selected generally by means of aptitude tests conducted by the aircraft plants or with the cooperation of the plants' employment departments.

In an analysis of certain plants, typical of the aircraft industry, direct labor represents approximately 67 percent of the total in the airframe industry, whereas, for the engine plant, direct labor represents approximately 65 percent of the total.

The average project airframe, unweighted with regard to quantity on order, requires 27,666 man-hours to fabricate. Of 22 models classed as Air Corps project airplanes the range is between a maximum of 114,500 and a minimum of 1,700 man-hours.

Machine Tools

It is recognized that machine tools are the master tools of industry due to the fact that they are not only capable of making all other machine tools and machine parts but also reproducing themselves. There are in the country about 400 companies making machine tools. Those which are exclusively machine tool builders number probably 200 to 250 individual companies. The others are in the main engineering concerns, foundries, and machine shops that make machine tools. The average annual production of the machine tools industry for 1935 to 1939 inclusive approximates $200,000,000, whereas the first six months' production for 1940, if continued, will achieve an annual rate of twice this figure, including machine tool parts and accessories.

Due to the high concentration of machine tool facilities, an additional program arises. This business started in New England something over a century ago, but as the need for machine tools spread to the West the industry followed. During the Civil War a group of manufacturers of machine tools began operating in Cin-

(*Turn to page* 130)

Labor Distribution of a Typical Airframe Manufacturer

DIRECT LABOR

Dept. or Type of Operation	Number of workmen	Per Cent
Machine Shop	342	9.4
Sheet Metal	441	12.1
Wood shop, mill and patterns	80	2.2
Processing	55	1.5
Finishing	200	5.5
Final assembly	321	8.8
Welding and tubing	171	4.7
Wing sub-assembly	452	12.4
Sub-assembly	208	5.7
Sheet metal sub-assembly	393	10.8
Drop hammer and hydro-press	87	2.4
Hull and frame assembly	240	6.6
Main wing assembly	230	6.3
Control surfaces	204	5.6
Final assembly—sub-assembly	77	2.1
Electrical assembly	106	2.9
Hydraulics	11	.3
Total	3,445	67.1

INDIRECT LABOR

Shop tool cribs	29	.8
Experimental	31	1.8
Jig construction	102	6.0
Finished parts stores	56	3.3
Plaster forms, foundry, etc.	41	2.4
Dispatch and follow-up	51	3.0
Plant maintenance	107	6.3
Shipping and crating	54	3.2
Production control	105	6.2
Plant police	22	1.3
Inspection	168	9.9
Loft and patterns	39	2.3
Material control stores	51	3.0
Flight test and service	12	.7
Factory clerical	24	1.4
Engineering	420	24.7
Production control, planning, material control, etc.	109	6.4
Shop supervision and foremen	73	4.3
Accounting, costs, payrolls, etc.	116	6.8
Factory and general clerical	43	2.5
Miscellaneous	77	4.5
Total	575	32.9

Labor Distribution of a Typical Engine Manufacturer

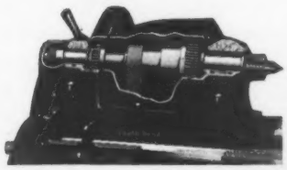
DIRECT LABOR

Dept. or Type of Operation	Number of workmen	Per Cent
Crankcase	670	11.0
Crankshaft	220	3.6
Connecting Rod	557	9.1
Cylinder	655	10.7
Grinding	263	4.3
Piston	98	1.6
Screw Machine	618	10.1
Rocker Arm	98	1.6
Heat Treat	171	2.8
Polishing	122	2.0
Assembly	1,046	17.1
Production Test	306	5.0
Tappet Guide	55	.9
Burring	128	2.1
Paint Shop	55	.9
Welding and Tube	73	1.2
Cam	80	1.3
Gear	899	14.7
Total	3,970	64.9

INDIRECT LABOR

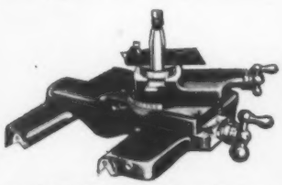
Maintenance	333	12.6
First Aid	13	.5
Tool Crib	58	2.2
Tool Room	285	10.8
Materials	344	13.0
Apprentice	214	8.1
Service Students	16	.6
Inspection	600	22.7
Exper. Machine	317	12.0
Exper. Assembly	193	7.3
Exper. Test	248	9.4
Exper. Hangar	21	.8
Total	928	35.1

Precision is Assured IN A SOUTH BEND LATH

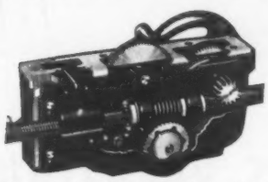


HEADSTOCK. Cutaway view showing integral type bearing and the capillary oiling system.

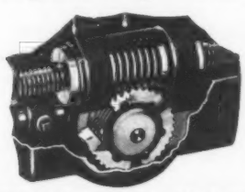
SUPERFINISHED SPINDLE is made of alloy steel with bearing surfaces carburized, hardened, ground and superfinished.



IMPROVED SADDLE and compound rest with adjustable tapered gibs. Cross slide bridge is wide and deep, providing rigid support for the tool rest.



DOUBLE WALL APRON is rigid box type construction with all steel gears running in oil bath.



MULTIPLE DISC CLUTCH. Cutaway view shows alternate keyed steel disc construction.

UNDERNEATH MOTOR DRIVE. Belt drive to spindle is smooth and powerful and provides a wide range of spindle speeds.

PRECISION is assured in South Bend Lathes by combining fine workmanship with sound machine design. Expert mechanics, skilled by years of experience, fit and test each unit with a degree of exactness known only to the machine tool builder.

South Bend Lathes are used in the tool and gauge departments of nationally known manufacturers for the most exacting classes of precision work. They are also used for production operations on interchangeable parts requiring a high degree of accuracy. Conveniently located controls assure an ease of operation which reduces operator fatigue, resulting in a uniformly efficient rate of production over a long period of time.

South Bend Lathes are manufactured in over 65 sizes and types. Popular sizes are available for prompt delivery from dealer display stocks in important cities throughout the world. Made in 9", 10", 13", 14½", and 16" swing, in 3' to 12' bed lengths, in Countershaft and Motor Drives.

ON DISPLAY IN ALL PRINCIPAL CITIES

Baltimore, Md.—Carey Machinery & Supply Co.
Boston, Mass.—The MacKenzie Machinery Co.
Bridgeport, Conn.—A. C. Bisgood
Buffalo. New York—R. C. Neal Company, Inc.
Cleveland, Ohio—Reynolds Machinery Co.
Dayton, Ohio—C. H. Gosiger Machinery Co.
Detroit, Mich.—Lee Machinery Company
Houston, Tex.—Wessendorff, Nelms & Company
Los Angeles, Cal.—Eccles & Davies Mach. Co.
Milwaukee, Wis.—W. A. Voell Machinery Co.
Newark, N. J.—J. R. Edwards Machinery Co.
New York, N. Y.—A. C. Colby Machinery Co.
Philadelphia, Pa.—W. B. Rapp, Machinery
Pittsburgh, Pa.—Tranter Manufacturing Co.
Portland, Ore.—Portland Machinery Company
Providence, R. I.—Geo. T. Reynolds & Son
Rochester, New York—Ogden R. Adams
St. Paul, Minn.—Robinson, Cary & Sands Co.
San Francisco, Cal.—Moore Machinery Co.
York, Pa.—York Machinery & Supply Company

SOUTH BEND LATHE WORKS

LATHE BUILDERS SINCE 1906

TRADE MARK CUTH TWINS

STINSON '105' *LENGTHENS VACATIONS*

Stinson stretches vacation time — lengthens years. As an implement of the good life, the '105' makes you live more intensely.

Take the case of the two doctors from California: Dr. Cecil R. Smith and Dr. J. H. Lorenz. With no high-priced and complicated flight gadgets, they walked out to the airport one morning, started their Stinson '105' and casually set their course for Central America. They flew over desert sands, jagged mountains, open water; they flew over forest, volcanos and jungles with confidence and ease. The Stinson '105' adds a new high to High-Adventure not only for the Alexanders, Hannibals, Byrons, but for the Doctor down the street, and the men who pass his office.

Mexicali, Guadalajara, Mexico City, Panama, from Village to Metropolis went Doctors Smith and Lorenz. Next year they want to circle South America, or explore the Arctic Circle with their new Stinson '105'. Life has new meaning and purpose. They will always be young.

Because it is easy for you to fly the Stinson '105' safely; because its initial cost and maintenance are low; because it has utility and beauty, this is your story too. You are the Doctor.

The Stinson '105' has built-in life assurance. A demonstration will convince you of the importance of such safety factors as Slots, Flaps, Hydraulic Brakes, and the Sturdy Stinson Construction. Its beauty is *more* than skin deep.

Write Dept. A-8 for your free copy of Stinson Plane News. See and read the most popular picture magazine of the Aircraft Industry.

Dr. Cecil R. Smith (right) and Dr. J. H. Lorenz (left) shown standing in front of the Stinson '105' on their return from a vacation trip by plane. Excerpts from their letter—"105 performed perfectly on trip to Central America—no trouble in over 88 hours of flying—covered over 8500 miles averaging nearly 21 miles to the gallon."

STINSON AIRCRAFT DIVISION

AVIATION MANUFACTURING CORP.

NASHVILLE Stinson **TENNESSEE**

Donald Douglas

(*Continued from page 45*)

airplanes. Compared to the practices of the past, production of airplanes will be concentrated and larger, but the popular conception of a marking belt with airplanes dropping off like doughnuts must be abandoned.

The above analysis of our military market under the existing emergency is of great importance because it illustrates the fact that aircraft production is a unique problem that is not to be solved by conventional mass production methods. We must keep our aircraft plants flexible so that we can tool up quickly for production on a new model plane. As the crisis grows, and especially if we should become involved in actual fighting, it will be essential for the various factories to be geared to the research laboratories and engineering departments. Our planes must always match those of the enemy. It is difficult to define the particular quality of aircraft production which sets it apart from other production methods. Probably the key thought behind efficient aircraft production is that it is a continuing quality of mind and men, rather than of machines. The aircraft plant is not a huge production machine to be tooled up, set in motion, and left to run without pause for a year or at a time. Aircraft manufacturing is more a process of organization and administration of the facilities of a whole host of industries. The aircraft builder must be vigilantly alert to every development that affects his operations. He must coordinate his activities with those of the radio, rubber, and petroleum industries. He must make full use of foundry, forge, and plastic industries. He must know and take advantage of the specialized facilities of parts and accessory builders. For example, he makes good use of the automotive industry for quantity orders of special machine parts, bearings, etc. Aircraft engine builders can sub-contract special operations, or make direct purchases of parts such as valves, gears, camshafts, crankshafts, etc. In this connection it is vital that good control be maintained over drawing up of specifications, and over inspection of the finished parts. The factors of research, engineering, production planning, inspection, all loom large in aircraft manufacturing.

Sheetmetal brakes must do little jobs as well as big ones to meet aircraft production needs.

We face several obstacles in the way of our expanded production program. First essential is the determination of a program to meet the need as visualized by our statesmen and military experts. This program must be precisely defined, both qualitatively and quantitatively. We must know what types of aircraft we need, what specifications they must meet, how many of each type we are to build, and how soon they have to be delivered.

Another obstacle is the shortage of trained personnel in the aircraft and allied industries. It will be necessary for the aircraft manufacturers and aircraft schools to develop a program in cooperation with existing public school facilities, for the rapid training of many kinds of mechanics and technicians. Probably the greatest single bottleneck is in the lack of qualified machinists, but there are many other shortages in the fields of hydraulics, instruments, electricians, etc.

Then we must establish a coordinated program for determining priority on orders for parts, supplies, materials, and accessories. Such a scheme will have to consider the needs of the aircraft manufacturers as against those of other industries, and also the individual needs of the various aircraft plants themselves. It is quite practicable to work out a plan which will assure smooth operation of all supply lines. But if this is not done whole factories may be thrown out of step by the shortage of some minor item such as a single type of ball bearing, a certain grade of alloy metal, etc.

Finally we must also set up a priority system on expediting machinery and equipment orders needed for the expansion of our aircraft plants. This means taking steps to speed up the production of such equipment as well as the proper apportioning of it to the various factories under expansion. Even now our machinery deliveries are much too slow, and this will become a crucial bottleneck in the face of a multiplication of present plant facilities, unless it is dealt with adequately.

Attaining our maximum aircraft production effort depends on several basic factors: (1) We must obtain the largest possible orders on aircraft of a single type. And once such orders are placed there must be no design changes to upset the production program. (2) It may become advisable to break down the design into the maximum possible number of component parts and to sub-contract to outside organizations. In all cases it is possible to speed production by separating the manufacturing operation into as many specialized, simplified, and independent forming, fabricating, and sub-assembling operations as possible. To successfully handle such large orders, and to properly coordinate the simultaneous production of sub-assemblies, it is essential tial that we achieve straight line flow of production to as high a degree as possible. This is achieved through intensive organization of design and production engineering, and of production planning and control. The ideal of such straight-line-flow manufacture is that parts and materials come in at one end of the factory and

Many complex profiling operations are performed on the rotary power shears, which speeds production.

Jack-of-all-trade days

. . . . we called them twenty-five years ago, when pilots "flew by the seat of their pants".

They checked their own control cords — and knew the name Roebling as standard equipment.

And today, too, despite the astonishing change in both men and materials, and with specifications of the Aviation Industry becoming increasingly severe, pilots still regard the Roebling name as assurance of utmost dependability, and they find the majority of the nation's planes are rigged with Roebling Control Cord.

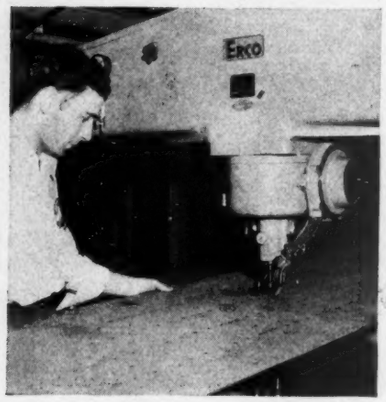
JOHN A. ROEBLING'S SONS CO., TRENTON, NEW JERSEY

Roebling Aircraft Products are available either tinned, galvanized or Stainless Steel, in regular or preformed constructions

KEEPING PACE WITH AN INDUSTRY WHOSE WATCHWORD IS PROGRESS

Brewster was the mark of quality on a carriage for over a hundred years, then a symbol for the finest custom automobile bodies made. Today Brewster stands for airplanes of superlative quality and performance.
Three great plants are now turning out more and more Brewsters every day—for a lasting mastery of the air.
Brewster
FIGHTERS AND DIVE BOMBERS
—for lasting mastery of the air

never stop, cross with other parts lines, or back-track, until they roll out the door at the other end of the factory in the form of a finished airplane. Of course we cannot achieve such an ideal, but we can cut to a minimum the lost time and motion that might be consumed by placing parts in storage and taking them out again, the time lost by workmen and



Special machines, such as this Erco punch and riveter, are used wherever possible to speed up production.

Douglas fitting being attached by use of a cross-head Phillips screw. Thousands of screws are used in a modern plane.

departments who might be held up for want of required materials or parts; the time lost through parts that do not fit or that do not pass inspection.

American aircraft builders have developed numerous unique processes for speeding production. We must continue such development work at an accelerated pace. In the past we have developed the Guerin process, or "rubber stamp" method of forming sheet metal parts, which eliminates the need for expensive steel dies and does many things that metal dies cannot do. We also have special profiling machinery, corrugating mill equipment, high speed machine tools, special welding machines, and numerous special production jigs, all of which are a direct result of inventive ingenuity exercised within the aircraft industry. We can be sure that continued development along this line will increase the speed and flexibility of aircraft production.

Assuming a modern and efficient plant layout, we can present the following suggestions on organizing aircraft manufacturing for greater production. Of first importance is the engineering department. American planes have won world-wide recognition largely due to superior engineering. Engineering performs many functions in addition to provision of increased performance and structural strength. Through engineering we conduct basic research of all kinds that is now more vital than ever. Such research usually takes several years to bear fruit so it is obvious that we must continue engineering efforts without neglecting production. Of most direct application to our production problem is the work of the production engineer. He examines the design during its development in order to find and suggest faster and more efficient ways of building it. Through the work of the production engineer many hours can be saved in the shop. In future we must further enlarge our production engineering work and find even better ways of coordinating the work of the shop and the production engineering department. With quantity production this becomes most important.

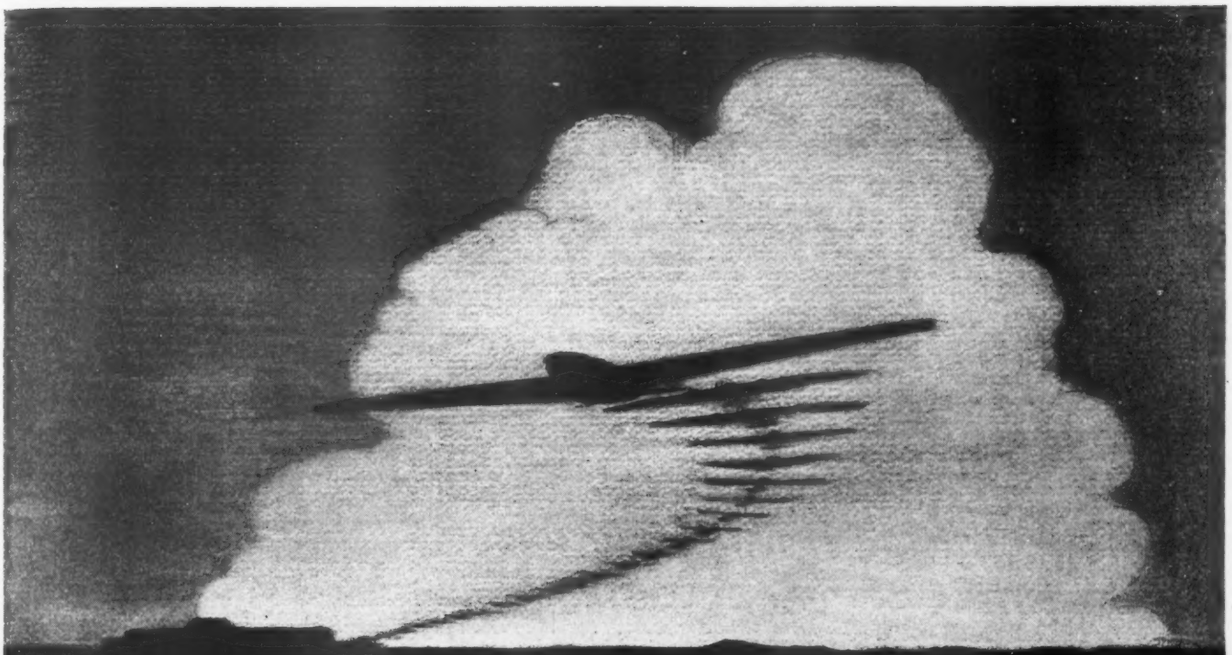
After engineering comes production planning, which must be followed by efficient production control. By proper production planning we make it possible to conduct any given manufacturing operation with maximum efficiency and minimum delay or interruption. Through close production control we insure the carrying out of our original production plan. It is obvious that an airplane without fuel pumps is as useless as an airplane without wings. Production planning and control makes certain that every part is in its place at the right moment throughout the manufacturing program.

Electric arc welding is one of the many special jobs being carried out in a plant building military airplanes.

We believe much attention should be given to the material department. Through setting up a well organized department for conducting purchasing and handling of material we can eliminate most of the bottlenecks that would otherwise occur during manufacture of an order. The material department maintains close liaison with all suppliers and sub-contractors. This department outguesses the bottlenecks by knowing in advance whether a given firm can meet delivery dates on a prospective order, and whether it can meet specifications covering parts or supplies to be ordered. Material is currently flowing into the Douglas plants by train, steamship, and airplane at the rate of $42,000,000 a year. This material must all be specified, ordered, handled, stored, inspected, and in some cases re-shipped, with the utmost efficiency. The aircraft industry cannot be looked upon as one industry located in one place. It is scores of separate industries and individual shops scattered the length and breadth of America. All must work together like a well lubricated engine, from the farmer raising the cotton that goes into fabric to cover control surfaces, to the machinist in South Bend turning out hydraulic equipment, before an airplane can fly. And it is the job of the material division to see to it that the products of these multitudinous activities flow smoothly to their destinations when they are needed.

Tooling has already been mentioned. But it should be emphasized that we cannot build planes without tools. We must have the right kinds of tools and enough of them. We need many tools of conventional types, such as metal shears, and brakes, presses, routers, draw bench equipment, heat treat furnaces, welding equipment, and all of these tools must be carefully selected to meet the needs of anticipated production. Then we need many tools of a specialized nature. Often we design and build these tools ourselves, or have them built to our specifications. We cannot afford to relax our efforts to develop newer and better production tools, jigs, and fixtures of all kinds.

The personnel problem is very real. We need trained workers and we need satisfactory conditions of work that will eliminate labor strife and insure maximum productive effort.



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this plane is part of every one that has ever been built, yet it differs from them all.

It may be the exact duplicate of a plane that was completed only yesterday, yet it stands apart, distinctly different.

It is the first plane to come off aircraft's mass production "lane" — something no one has seen — and as such it is the wonder of this era. For conventional methods of mass production could not produce it.

From not one of hundreds of industries employing some form of mechanical handling system with excellent results, can a single installation be borrowed in full and applied to the aircraft industry. But the same *principles* of mass production can be. And from these principles will be evolved a method.

With a thorough knowledge of such mass production problems and their solutions and with the conviction that no complete system that has served any other industry will suffice, Mechanical Handling Systems offers its full cooperation to the aircraft industry — builders of the *fifty thousand.*

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MANUFACTURING ENGINEERS 4622 NANCY AVE., DETROIT, MICHIGAN

Defense Procurements

(*Continued from page 122*)

cinnati and that city is the center of the Mid-Eastern machine tool area which shares with New England the distinction of being the important machine tool centers in the United States. The rearmament program, particularly the foreign requirements on our machine tool industry, contributes to the seriousness of the machine tool shortage today. Under emergency conditions the machine tool requirements of the services would be placed in high priority and it is felt that no serious problem is involved. "The American Machinist" has estimated that 70 percent of the machine tools in the country in 1940 were more than ten years old. However, the aircraft industry is in a much better position, due in large part to the fact that it is a comparatively young industry and recent augmentation programs have improved this condition.

Transportation

An interesting observation bearing on contributory services and parts is the fact that 55 percent of the average requirements for aircraft fabrication is shipped in excess of 1,500 miles for assembly, without considering the ultimate destination of the airplane.

Gasoline

The fuel industry in cooperation with the services has developed high octane fuels in recent years. These are necessary for the best operation of aircraft. The so-called 100 octane fuel is the Air Corps standard but represents a small proportion of the total gasoline output. However, of the high octane fuels the Air Corps requirements represent a considerable porportion of the total high octane fuel output. The special processing incident to the gasoline cracking process and lead treatment has necessitated new plant installations on the part of the gasoline industry.

Miscellaneous Equipment

Parachutes

Substitutes for silk for parachutes is likely to be solved by the use of Nylon and related synthetic fibers.

Flying Clothing

High altitude flying clothing and shoes with lamb shearing lining are a product requiring problems of hide selection which has made it essential that specifications be modified in order to avoid the necessity of reliance upon foreign sources.

Other Textiles

Webbing of linen and cotton are necessary items in the Air Corps procurement problem, however, they constitute but a small proportion of the industrial output of these products.

Optics

Bomb sights, drift meters, cameras and field lighting equipment have again emphasized the inadequacy of domestic lens sources to fulfill Air Corps and other military requirements.

Paper

Specially processed paper for electrical windings has until recently been difficult to obtain from domestic sources.

Airplane Evaluation Procedure

Illustrative of the Air Corps purchasing methods for airplanes are the following pertinent steps:

All airplanes submitted in accordance with Air Corps procedure for award are rated by a board of Air Corps officers. The contracts are then drawn for the type which is adjudged to have won the award by this board of officers, incorporating the privilege of modifying certain details of design which will contribute toward improving economy of manufacture, operation, performance or speeding up manufacture. This airplane, having been designed, around a specific engine and for a specific purpose, will incorporate Government-furnished-equipment, including accessories, armament, and flight instruments.

As a general statement, the actual selection of qualified companies, assuring the Air Corps of deliveries in a well-balanced aircraft program is no longer a serious problem. This is due to the ability of proven companies to expand their manufacturing facilities for proper coordination with contributory facilities, permitting parts and

Latest Developments of Defense Program

A 25,000-PLANE aircraft program has been completed—on paper—the defense commission says. George Mead, Knudsen's aircraft specialist, has worked out with Army, Navy, and the British a plan to standardize on existing types. What types have been standardized on is supposed to be a military secret, but it's understood that the plan means essentially that we will continue to build the planes we are building now, turning them out in quantity without changing the specifications every other day.

A start has been made on the next step of allocating production among manufacturers. On the 4,700 combat ships and 3,900 trainers already appropriated for, contracts are about ready to award, pending solution of the amortization tangle, and negotiations are underway on the 19,000 additional ships in the pending $5,000,000,000 defense appropriation.

Perhaps almost as important for quick production, Mead has induced the Army and Navy to agree on a common contract form, so that manufacturers doing work for both services won't have to have two different procedures. There won't be two sets of inspectors either, because whichever service has placed most work with a particular firm will follow through on all its contracts.

A brand new purchasing procedure for Army and Navy airplanes (and other military supplies) is set up by legislation enacted to govern the expenditure of the huge defense appropriations. Competitive bidding is out, its place taken by negotiated contracts, and gross profits will be limited.

Airplane manufacturers come under the same profit limitation schedule as armament industries generally, although Congress's original intention was to continue and stiffen the special Vinson-Tramel limitations applying only to ships and aircraft. These caused so much delay in contract negotiations, that Congressional and administration leaders got together and announced in advance that Vinson-Tramel rules would be eliminated by the war profits tax bill. During the interim, work has proceeded on the basis of informal agreements, with final contracts deferred until the legal situation clears up.

Any profit limitation scheme raises the possibility, remote as it may be, that manufacturers might refuse to cooperate on the terms set. To meet this contingency, the new legislation empowers Army and Navy to manufacture what they need themselves; they may build new plants or lease existing plants and either operate them themselves or contract for their operation. The Secretary of the Navy, if he finds he needs a given plant, may determine a fair rent and compel the owner to lease it to him. The Secretary of War, curiously enough, does not yet have this power, but legislation is in preparation to give it to him.

Walsh-Healey prevailing wage and overtime pay provisions continue to apply. They were opposed by Army and Navy spokesmen, but Congress ended by throwing the problem in the President's lap, empowering him to waive the law if he sees fit. He probably won't.

Substitution of negotiated contracts for competitive bidding on military supplies, will not change procedure on buying of airplanes as much as on some other items. Competition in the past has really been competition on quality, with price settled by negotiation. The new procedure will merely eliminate some red tape.

The government may advance 30 percent of the amount of a contract to the contractor, to aid in the acquisition of the necessary plant.

"One Nation Indivisible..."

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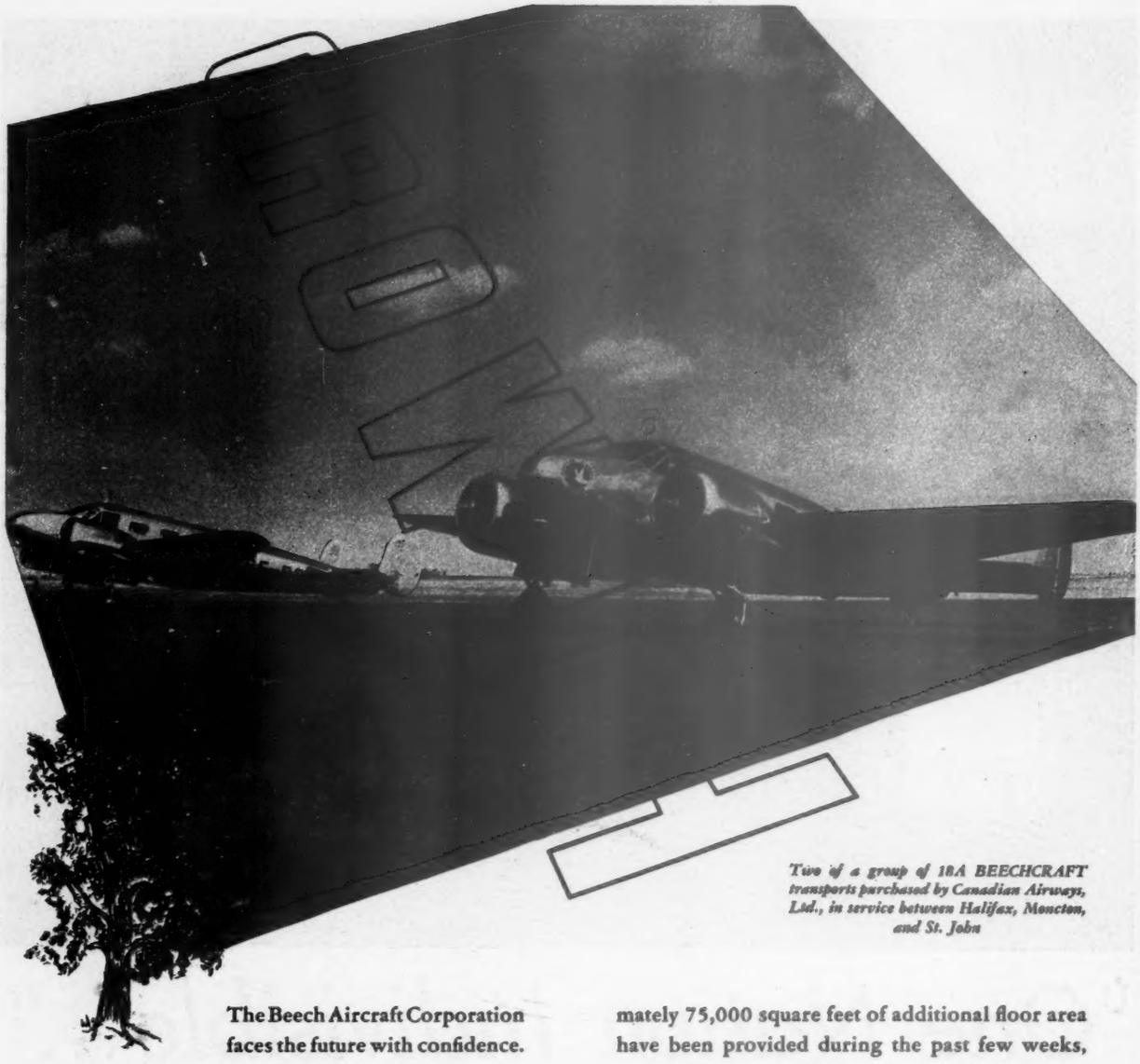

Two of a group of 18A BEECHCRAFT transports purchased by Canadian Airways, Ltd., in service between Halifax, Moncton, and St. John

The Beech Aircraft Corporation faces the future with confidence. Its personnel are making every effort to co-operate fully with the officials of the United States Government in order that the BEECHCRAFT contribution to the Defense Program shall have the maximum possible value.

The size of Beech Airport has been doubled and now comprises an area a mile long (into the prevailing winds) by one-half mile wide. Approximately 75,000 square feet of additional floor area have been provided during the past few weeks, and much larger additions to plant facilities are being laid out.

Present production, as measured by deliveries, is approximately three times that of a year ago and is now the largest in the history of the company.

Commercial, private, and export orders are actively solicited and welcomed. However, deliveries are necessarily subject to Government priorities under the present emergency conditions.

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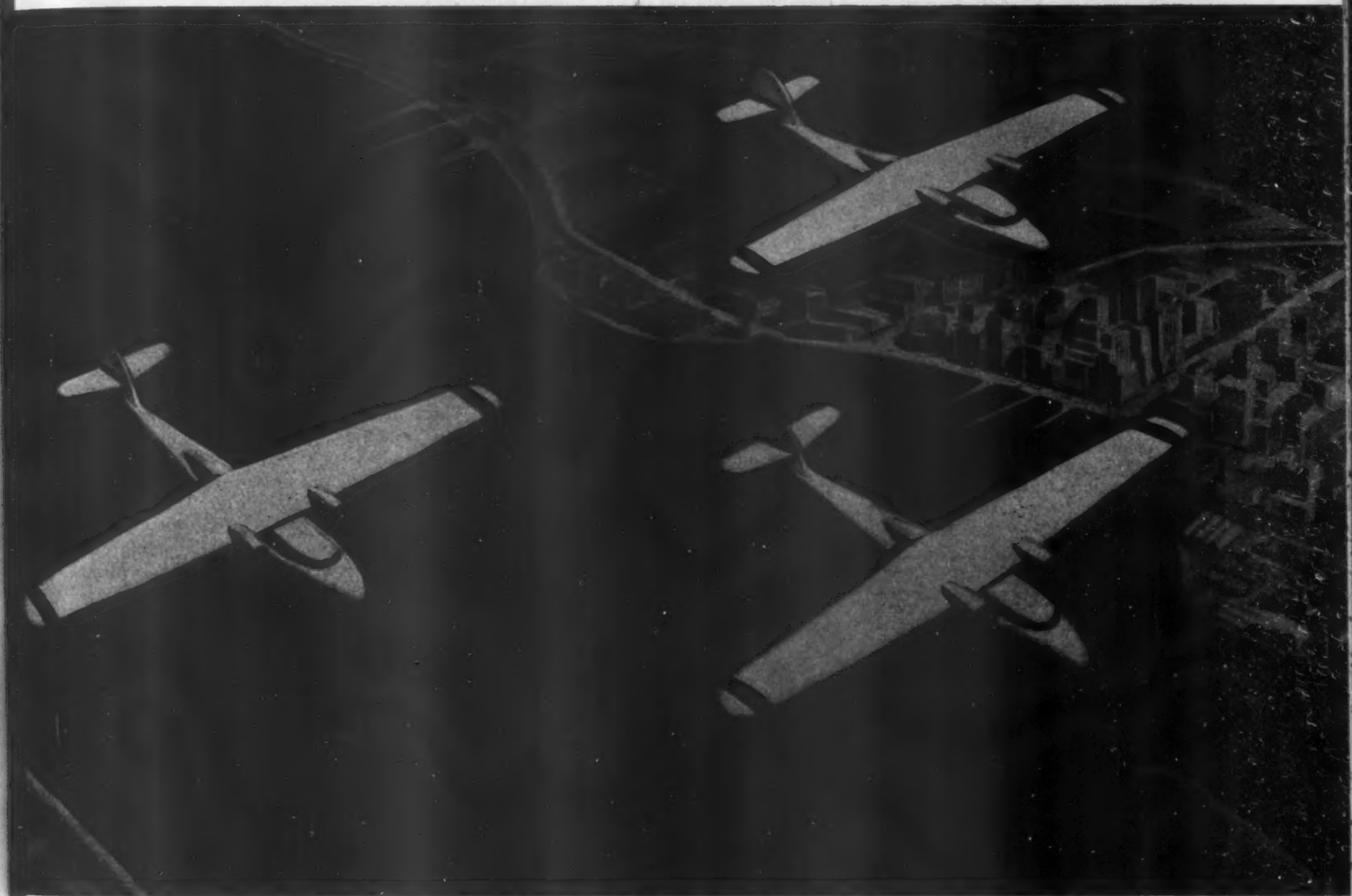

Drop forgings or upset forgings, from a few ounces up to 200 pounds, simple or complex designs, from steel and alloy steels, fabricated in standard types of equipment to close tolerances.

Die making promptly accomplished to accelerate production. T & W operates one of the largest and most skillful die making departments in the forging industry.

Magnaflux inspection of all aircraft forgings within our own plant, and with latest design magnaflux testing machine.

Forgings in which uniformity of physical properties, after heat treating, is obtainable in exact degree required.

T & W offers engineering assistance, seasoned by active cooperation with aircraft designers and engineers, for working out problems incident to die sinking and fabricating of forgings. T & W engineers quickly comprehend requirements relating to each operation in fabricating and finishing aircraft forgings. This usually results in forgings that cost less at the point of assembly.

T & W is now serving several prominent makers of aircraft units, whose standards are known to be exact and precise.

T & W is fully equipped to produce ordnance, navy, and Diesel forgings.

For those manufacturers having their own forging equipment, T & W will gladly quote on die requirements.

Consult a T & W engineer about how to obtain *aircraft forgings that cost less at the point of assembly.* Phone, wire, or write us direct at Alliance, Ohio.

FORGINGS USUALLY COST LESS AT THE POINT OF ASSEMBLY

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ALLIANCE, OHIO

services to flow into the airplane plants almost perfectly timed. Thus the expanded facilities for the manufacture of starters, carburetors, oleo gears, aluminum sheet, steel forgings and the many other items have gone forward in orderly steps with the increased manufacturing and assembly facilities of important airframe and engine supply sources.

Procurement For Present Conditions

The Air Corps has recently set up three procurement districts—the Eastern, Central and Western. At present officers or civilian inspectors stationed at important aeronautical plants are serving temporarily as Air Corps representatives on Procurement Plannings as well as performing the inspection functions in their respective districts. Thus, whereas the war-time organization chart indicates procurement offices with augmented field staffs in Chicago, Detroit, Cleveland and Buffalo in addition to sub-procurement offices, which may be required, the Air Corps is administering the first four mentioned from its existing district offices.

Experimental Engineering and Research

The relationship of the engineering problems to the airplane are manifest in the early title of the Air Corps material division. It was first known as the Air Corps engineering division.

Wright Field, Dayton, Ohio, is the location of the Air Corps engineering activities with its many complex research problems. It includes among the many other activities, a physiological laboratory. This is a part of the equipment laboratory carrying on research arising from flight operations. These studies have necessitated the installation of sealed chambers for simulating altitude conditions.

Much of the research is coordinated with other federal agencies, notably the N.A.C.A. and the C.A.A. and other branches of the Army and Navy.

Important, too, is the cooperation of industry which includes all those who contribute to the successful flight of man. These contributions have been many and valuable and have assured the United States of an Air Corps second to none in quality and with the current impetus, second to none in quantity. In this field of research, the Air Corps' superiority is assured.

Sub-Contracting . . . Jansen

(*Continued from page 49*)

with the amount of that possible capacity, and know our total requirements, we realize it covers only a small percentage of our needs.

After determining what this additional capacity will produce in the allotted time the next step can be to fill up all existing aircraft capacity to the limit and expand with brick and mortar or necessary equipment the airplane companies whose airplanes are desired in the program.

Supposing that an airplane company has 10,000 people, direct labor, and the plant facilities and equipment to operate efficiently. It is much simpler to double that capacity than it is to create new capacity elsewhere from zero. I feel that the so-called "brick and mortar" and additional equipment cost is considered more of a bug-bear than it should be. There is no substitute for time and since we plan to have certain things at a specified date there is no juggler's act to produce them. If we consider the total cost of the anticipated program, the cost of expansion under the worst condition is a very small percentage of the total.

There is no time for dilly-dallying and hoping that would-be sub-contractors can do the impossible. The time for large scale sub-contracting and of enough volume to meet the first phase of our expansion program is out of the question.

The first part of our program should be to occupy all existing facilities with a product that is beyond the drafting board stage and is actually in production with adequate tools. It may not be the most desirable but it certainly would form the foundation and give us a start on expansion and training of personnel. The second step should be immediate preparation for building airplanes that are now considered satisfactory experimentally, or which are near completion on the drafting board and which can go into production in a short time. The third step should be the intensive research and development for the very latest types for production after we get under way on the first two.

While real expansion is taking place we should look around for still more existing capacity that could be converted and utilized for aircraft production in the second phase. We do not want any promotion schemes but sincerity of purpose and hard work for a job to be done. To build new capacity, even with private funds, and leave it in the hands of people with good intentions but without experience is simply taking away something that the airplane manufacturer needs. Good equipment will be at a premium and the same is true of skilled labor. Why then turn such important commodities over to those who don't know how to do the job, instead of adding it to existing capacity? It certainly seems a better plan to stretch and add on to existing organizations than to start over new without experience. Any degree of success that a newly formed company without experience may gain has to be with the aid of something taken away from existing companies.

There still is some capacity that can be cultivated into reliable sources of supply. We have investigated many sources and found that with the best of intentions most are ill-equipped and entirely unprepared to handle aircraft work in the near future. Others, however, have possibilities, and with training can be of great help. As far as adapting automobile plants or any other mass production industry to build airplanes in large quantities at a very early date—that is definitely an impossibility. I believe that many who have proposed these plans are sincere in their belief that it can be done. I would agree with them except for the time element, and the fact that airplane design simply is not "frozen" to the point of so-called mass production based on two or three year plans.

The second phase or long range program, must be considered now if it is planned to convert to mass production. With education much can be accomplished, but those responsible for such a plan must embark upon it without hesitation or interference and be willing to spend huge sums of money at once, expect no short-cuts and no results for some time.

In previous writings I have expressed my thoughts on sub-contracting and national defense in general, and after a careful survey of the existing situation I have not changed my mind very much. Since the machine and tool-making trades are universal I still feel that machined parts and tools can be most readily subcontracted for, providing of course, equipment is available. Machine tool practices are quite universal and drawings for such parts can be made clear. Tolerances and descriptive notes are generally understood and for that rea-

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There is a NORMA-HOFFMANN PRECISION BEARING for every load, speed and duty — 108 series and more than 3000 sizes. In this comprehensive line, American manufacturers serving the aviation industry find the solution of their bearing problems — employing these PRECISION BEARINGS in aircraft, engines, instruments, aircraft equipment and accessories, radio and photographic apparatus, and landing field equipment. Write for the Catalog. Let our engineers work with you.

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"Where the bearings must not fail", NORMA-HOFFMANN PRECISION BEARINGS are the choice of the engineers and designers of practically every representative American builder of planes — for military, commercial, or private use.

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This *advanced* training, coupled with supervisory and leadership experience, will equip graduates to reach and fill key positions in the field.

Classes will begin in September and March of each year. Enrollment is strictly limited and students are selected from high school and college graduates.

Prospective students are invited to write for catalog and detailed information, enclosing with request a brief outline of their background.

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son a machined aircraft part is not as special as those parts made by other methods. Most contractors at first do have difficulty with the materials we specify, also with processes such as heat treat. Nor do they understand the need for adherence to specifications. However, these short-comings can be cleared up in a short time.

It is not very difficult to obtain small stampings, but we have found that since the number of man hours going into such parts is small, the effort of subcontracting and handling is not always worthwhile. There are certain small units such as tails, ammunition boxes, engine mounts and etc. that may, with some preliminary study and educational work, be sent out. To obtain miscellaneous detail parts from many different sources and assemble them in the main plant has some advantages but more draw-backs. It would be my recommendation that the number of sources of subcontracting be held to a minimum and concentrate as much as possible on one kind of work at one place. Since the airplane companies must exercise extensive control in tooling and inspection it is much easier to do this on the above plan than scattering a great variety of work all over. It is sincerely hoped that those who direct our programs and those who are now doing subcontracting work or who are anxious to participate in the business face the problem realistically.

Recent Books

WINGS OVER THE AMERICAS, *by Alice Rogers Hager.* Macmillan, N. Y. 162 pages. $2.50.

Everyone who has ever wanted to fly around South America—and who hasn't—will enjoy this new book of Alice Hager's. It is a story of her flight last summer via Pan American routes from Miami to Cuba, Yucatan, Mexico, through Central America, and down the west coast to Chile, over the hump to B.A. and back up the east coast.

The author has packed a tremendous amount of fascinating information into her book. Basically she tells the story of her flight, where she went, what she saw and how this great international airline is operated. But the book is more than just another flight story. It is filled with the reactions of a wide-awake reporter travelling through many countries that are very much in the public eye today.

Mrs. Hager is a newspaper woman of considerable experience who knows aviation from first-hand knowledge.

How to Get CAA Training

(Continued from page 58)

can get either, whether you're in college or not. If in college, you must be in one of the 500 schools in the CAA program. For preliminary, you must be between 18 and 26 years old, must meet the regular physical requirements. If in college, you must meet the educational requirements. If non-college, you must complete the ground school course among the ten highest ranking students to be eligible for flight training. This course is 72 hours of ground work and 35 to 50 hours in the air.

For secondary, or advanced training you must have completed the preliminary course and hold an active private pilot's certificate. You must meet the physical requirements of the Army or Navy for flight training and you must be selected by the institution giving the ground training. This course is 145 hours of ground work, and 45 to 50 hours of flight instruction.

The preliminary and secondary courses combined are the approximate equivalent of the primary stage of training in the air services of Army or Navy. Which means that, if you chose to enter either service and were accepted, you would skip the basic training stage.

Then come the instructors courses. They are a continuation of the preliminary and secondary pilot courses. The idea is to train more instructors for the CAA program. The instructor courses are three: (1) apprentice, (2) primary instructor course, and (3) secondary instructor course.

To qualify for the apprentice course, the applicant must have successfully completed the pilot secondary course, and must be between the ages of 18 and 26 and must meet the physical requirements. Training is 25 to 35 hours in flight and the methods of instruction. The ground course is 20 hours, devoted to analysis of flight maneuvers. Applicants who successfully complete this course are eligible for inclusion in the preliminary program as apprentice instructors. Each will be given a quota of students to train, and upon successful completion of the quota, will be eligible for certification as a re-rated instructor.

The primary instructors course is 10 to 15 hours each of ground and flight training, dealing mostly with teaching the pilot to analyze flight maneuvers and impart them to his students. Applicants must hold active commercial certificates and be between the ages of 21 and 40.

The secondary instructor course is open to all commercial pilots between the ages of 21 and 40 who hold primary re-rated instructor's certificates and are employed by an operator who has been designated to give secondary training. This is secondary training which will qualify the instructor to train secondary students.

That's all of the instructor courses. Now there are three "refresher" courses, for (1) solo pilots, (2) for private pilots, and (3) for commercial pilots.

The solo refresher is mainly intended to polish up the ordinary pilot and qualify him to hold a private pilot's certificate. The applicant must hold, or have held, a solo certificate, or the equivalent in flight time, be a high school graduate, and be 18 to 26 years old. The course is 25 to 35 hours of flight and 72 hours of ground training, same as the college and non-college ground work.

The refresher course is intended to standardize the private pilot who has not graduated from a control system. Qualifications are the same, except applicants must hold or have held a private certificate. The air time is 15 hours and a review of the 72-hour ground course is required.

The commercial refresher course is open to any active or inactive commercial pilot between the ages of 21 and 40 who can meet the physical requirements. In addition to 15 to 25 hours of flight time, the pilot reviews airplanes, engines, instruments, parachutes, meteorology, navigation, and civil air regulations. This course standardizes him as a commercial pilot under the CAA system, and he may qualify as a primary instructor.

Now, if you graduate from a CAA course you'll be a good pilot, or a better one than you were before, but you will need regular practice to keep your hand in, and time in the air to be able to renew your license. The best thing to do is buy an airplane. But if you can't do that, your Uncle Sam again comes to the rescue with that "syllabus" course. It's good for the necessary 15 hours in Latin or any language. If you're an active private pilot, who has graduated from one of the CAA controlled courses, you're okay for it.

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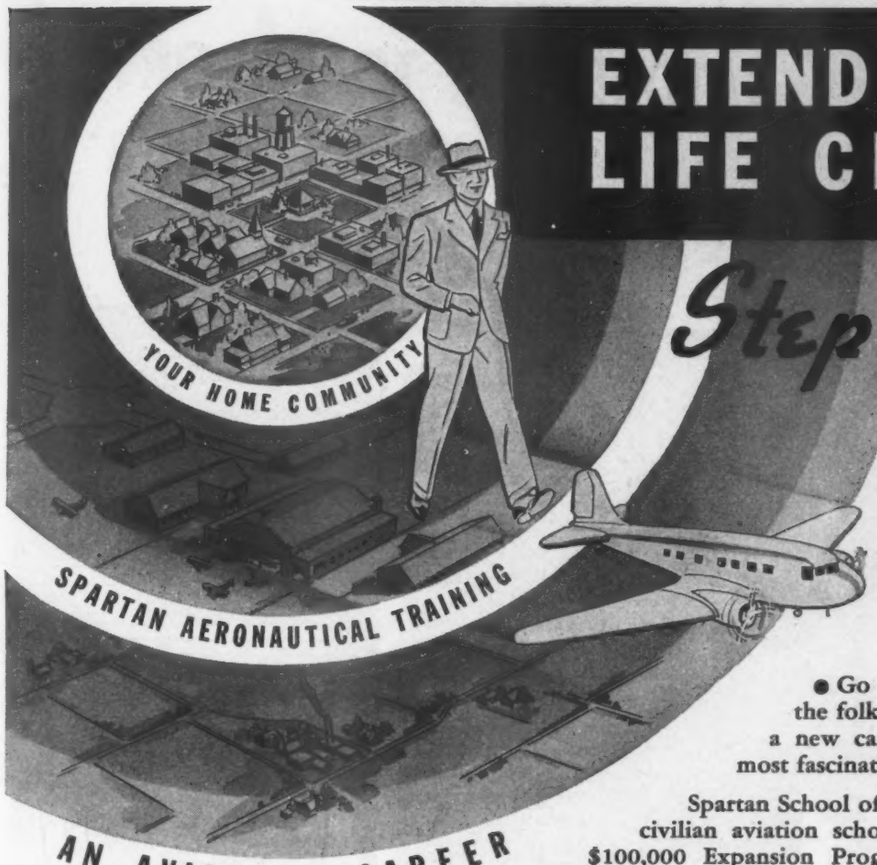

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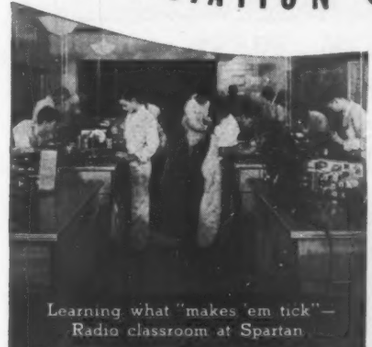
Here you get complete training in Flight—Engineering—Mechanics—Radio. You have the facilities of modern shops, hangars, laboratories and classrooms with modern engines, airplanes and equipment. You live in spacious club-like dormitories, and dine in a first-class school-operated restaurant.

Spartan Aviation training is recognized by the aviation industry as meeting highest standards of professional quality. This school is approved by the Civil Aeronautics Authority. Your instructors are carefully selected for experience, character and teaching ability.

You will enjoy living and learning at Spartan School in hospitable Tulsa, "Most Progressive City In The Mid-West". Open the gates of your world to new triumphs. Mail the Coupon for Free information about Spartan School. Next semester starts September 30th.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One of the spacious new classroom buildings

Precision work on fine engines is done at Spartan's Approved Repair Station

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DIVISION OF SPARTAN AIRCRAFT COMPANY

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Dept. A-80, Tulsa, Oklahoma

Send me your new 1940 Catalog describing in detail the SPARTAN courses I have checked; also stating tuition and living expenses.

NAME..... Age.....

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City..... State.....

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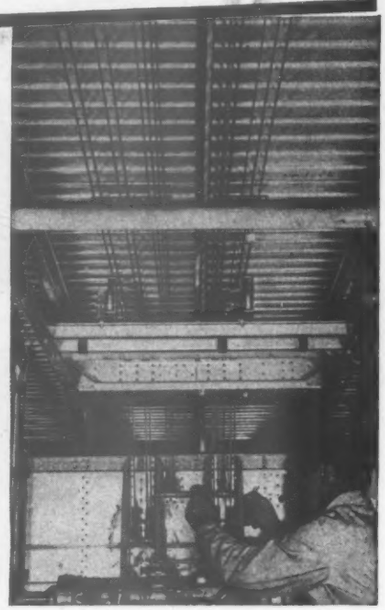
Check Courses You Prefer

- ☐ Air Transport Pilot
- ☐ Airline Maintenance Engineering
- ☐ Aeronautical Engineering
- ☐ Air Transport Operations
- ☐ Airline Service Mechanic
- ☐ Aircraft or Engine Mechanic
- ☐ Commercial Pilot
- ☐ Air Transport Radio Communications
- ☐ Aircraft Factory Mechanic
- ☐ Private Pilot (6)

NEW SUB-STRATOSPHERE TRANSPORT

Controlled with American Tiger Brand Aircraft Strand and Cords

Making final adjustments on control cables. These cables are a part of the intricate system controlling ailerons, elevators, wing flaps and rudder. All control rigging is of American Tiger Brand Aircraft Strand and Cords.



MEET GOVERNMENT SPECIFICATIONS

American Tiger Brand Aircraft Strand and Cords fully meet the requirements of the latest U. S. Army and Navy Specifications. They are available in either tinned, galvanized, or U·S·S Stainless Steel, in the following constructions:

19-wire Strand	semi-rigid
7 x 7 Cord	flexible
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These products offer superior strength, fatigue resistance, and minimum stretch. They are composed of uniformly cold-worked wire, precision-drawn to high tensile strength.

CENTER of interest in aviation circles today is the new Curtiss-Wright Sub-stratosphere Airliner, now undergoing flight tests at St. Louis, Mo. This ship, a marvel of modern aeronautical engineering, is America's largest twin-engined transport. It seats 36 passengers by day, sleeps 20 by night, and has a cargo capacity of 5200 pounds.

Curtiss-Wright engineers have simplified the pilot's operation of this new skyliner by reducing the total number of flight controls 33 per cent. Another unique control feature is the "Tell Tale" device which automatically checks 50 major instruments and controls for the pilot.

These innovations call for control cables of only the finest types. That's why you'll find this ship, like other outstanding modern aircraft, rigged entirely with American Tiger Brand Aircraft Strand and Cords. Used in flying controls and engine controls of America's leading airplanes, these cables are a standard specification of successful aircraft designers and builders.

Write today for complete data.

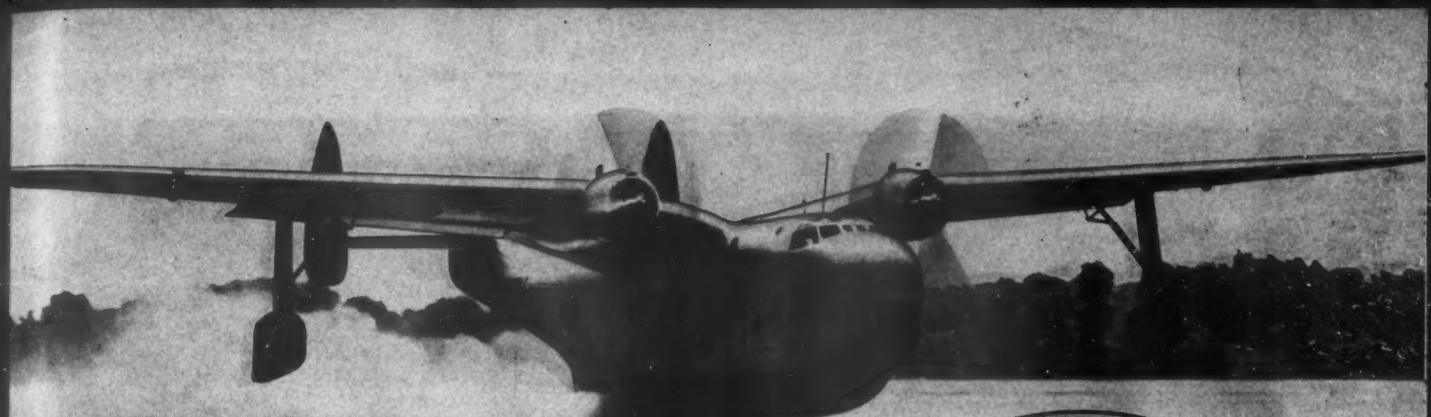
AMERICAN STEEL & WIRE COMPANY

Cleveland, Chicago and New York

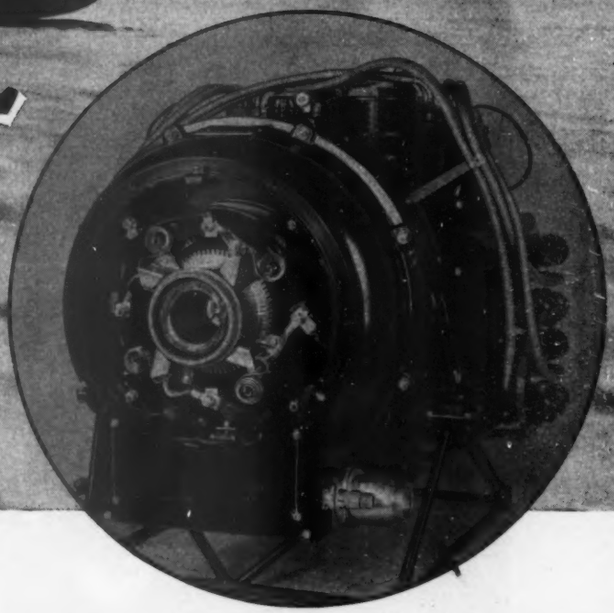
Columbia Steel Company, San Francisco, *Pacific Coast Distributors*

United States Steel Export Company, New York

UNITED STATES STEEL



Auxiliary power for Navy Bombers



NEW WESTINGHOUSE GENERATORS SUPPLY POWER FOR ACCESSORIES IN MARTIN NAVY BOMBERS

THEIR EXPERIENCE WORKS FOR YOU

Since the industry began, Westinghouse engineers have worked side by side with aviation men to develop electrical equipment to meet their specific requirements. Take advantage of these years of close association with the aviation industry on your next electrical problem.

Tune in "Musical Americana," N.B.C. Network, Coast-to-Coast, every Tuesday evening.

TWO complete auxiliary power plants, that meet the requirements of long-range, high altitude flying, are installed in each of these Navy Patrol Bombers. These new units are compact, engine-driven generators and associated electrical equipment, co-ordinated in design by Westinghouse. They supply all the power for the operation of accessories such as radio, bomb doors, retractable floats and hot plates.

New developments like the auxiliary generator, the Seadrome and latest sodium-contact lights are but a few of the results of Westinghouse research that help to keep American aviation in the lead today.

Our intimate association and long experience with both plane user and maker enable us to supply the most trustworthy electrical aviation equipment. Your local Westinghouse office will give you fast service on any requirement.

WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY
EAST PITTSBURGH, PA.

J-95017

Westinghouse

ELECTRICAL PARTNER OF THE AVIATION INDUSTRY

W
WESTINGHOUSE ELECTRIC

Billions for Defense

(*Continued from page 32*)

and set profit limits on these two vital defense industries. Why these particular defense industries should have been treated as step-children is a long and somewhat unpleasant story and has no place here. Instead of removing this impairment to progress when the present emergency was recognized, Congress went to work to make a bad situation worse by cutting the limits from 12 to 7 percent. When you deduct federal taxes and other expenses included in the 7 percent you are lucky if you wind up with 4½ percent. Your stockholders money will do much better for them in chewing gum, candy, or soft drink manufacturing investments. And of course it will pay them better to invest in any defense industry but shipbuilding or aviation.

As this is being written the enlightenment of the Army and Navy on this problem has spread to the Administration and the profit limitation seems to be headed for the discard. Inclusion of the aviation industry under prospective excess profits legislation is expected as a substitute and with this arrangement no aviation manufacturer will quarrel.

Expansion bottleneck No. 2 is the Treasury Department income tax amortization policy which is still unsettled. Investors naturally want to know how fast they can depreciate a potential white elephant in their corporation income tax returns. There is some light here too, and four to five years has been recommended as a basis for new plant depreciation. But while Congress is on its Convention vacation nothing can be done to make this legal. So contracts are being discussed on a gentlemen's agreement basis.

As we go to press, contracts aggregating $160,000,000 have been cleared by the Defense Commission. Manufacturers have been asked to rebid on older awards in the light of the greater quantities involved in the new contracts. But while there will be some reduction in the unit cost per plane as a result of the larger orders, the extra cost of accelerated delivery will keep up the net cost of the program. Reasons are that much of the production savings will be offset by the necessity of inefficient third shifts, six-day weeks with high overtime costs, plant amortization costs, and the necessity for subcontractors to charge higher prices to amortize required new equipment at a rapid rate.

By popular demand the aircraft industry is on its way to the greatest expansion in its history and probably one of the greatest in the history of all industry. The magnitude of this undertaking is not fully realized by the man in the street. Fortunately the industry is thoroughly competent and well equipped by experience and background to do the job and it is probably the best prepared of any defense industry. But some delays and stumbling blocks are almost inevitable at the start. If these factors are clearly understood by all concerned and the present indications of government cooperation materialize, the nation should be thoroughly satisfied with the results.

Window Shopping

(*Continued from page 81*)

The following trade literature may be obtained by writing direct to the firms listed:

Airco Electric Welding Products—A 32-page illustrated booklet describing the complete line of Airco electrodes and Wilson electric welding machines. Catalog No. 103. Air Reduction, 60 East 42nd St., New York, N. Y.

American Screws and Bolts—Catalog No. 40—A handsome 106-pg. loose-leaf bound catalog of the complete line of American screws and bolts, with special emphasis on the latest developments in Phillips recessed head self centering screws. American Screw Company, Providence, R. I.

Bonney Forge & Tool Works—Catalog No. 140—Popular 5" x 7" size, contains 96 pages illustrating the complete line of Bonney hand tools. Bonney Forge & Tool Works, Allentown, Penna.

"The Fabrication of U. S. S. Stainless Steels"—A 92-pg. book ($1 per copy) divided into three comprehensive sections covering all phases of working and fabricating stainless steel parts. Carnegie-Illinois Steel Corporation, Pittsburgh, Penna.

Caterpillar Diesel Engines—An 8-pg. folder covering recent models of power units, generator sets, and marine engines. Caterpillar Tractor Co., Peoria, Ill.

Elastic Self-Locking Stop Nuts—A folder describing what they are and how they work. Elastic Stop Nut Corp., 2330 Vauxhall Road, Union, N. J.

Garrison Gear Chuck Chuckgrams—A single-sheet chuck information service of value to any shop with gear chucking problems. Barrison Machine Works, Inc., Dayton, Ohio.

The Hypressure Jenny—A folder describing this high pressure portable steam cleaning plant. Hypressure Jenny Division, Homestead Valve Mfg. Co., Coraopolis, Penna.

Micromax and Other Pyrometers—Broadside N-33—An attractive broadside folder with up-to-the-minute information for anyone interested in indicating, recording, or controlling industrial temperatures. Leeds & Northrup Company, 4004 Stenton Ave., Philadelphia, Penna.

The Librascope as Applied to Aircraft—An attractive booklet describing the unique Librascope Balance Computer for rapid determination of aircraft gross weight and cg location. Librascope, Inc., 6657 West San Fernando Road, Glendale, Calif.

Procedure Handbook of Arc Welding Design and Practice—($1.50 per copy) Contains 1125 pages and 1557 illustrations. Encyclopedic in scope! The Lincold Electric Company, 12818 Coit Road, Cleveland, Ohio.

"Making the Most of Die Castings" and "Die Cast or Sand Cast"—Two helpful pamphlets for all engineers dealing with with die castings. The New Jersey Zinc Company, 160 Front St., New York, N. Y.

Firefax—Regular fire equipment publication issued by the Pyrene company. Carries worthwhile fire prevention advice. Pyrene Manufacturing Company, 671 Broad St., Newark, N. J.

Panel Instruments—Catalog No. 4120—Covers complete line of ammeters and voltmeters. Roller-Smith Company, Bethlehem, Penna.

Reed Micrometers—Folder describing latest equipment of this type. George Scherr Co., Inc., 128 Lafayette St., New York, N. Y.

Planning the Industrial Apprentice Training Shop—A bulletin offering various shop layouts planned for efficient vocational training in machine tool work. South Bend Lathe Work, South Bend, Indiana.

Ermeto Safety Fitting—Catalog A 401—A handsome 24-pg. catalog presenting an advanced type safety tube fitting for all purposes and materials. The Weatherhead Company, Cleveland, Ohio.

Fractional Horsepower Motor Leaflet—A 2 page illustrated leaflet describing type FS polyphase squirrel cage induction motors of 1/6 to ¾ h. p.

Nofuze Panelboards—A 4-pg booklet F-8549—illustrating three primary types of electric panelboards for lighting or low capacity power distribution control. Westinghouse Electric & Manufacturing, Company, East Pittsburgh, Penna.

Twist Drills—A new circular listing various types of high speed and carbon steel drills. Whitman & Barnes, 2108 West Fort St., Detroit, Michigan.

Hydraulic Equipment, Catalog No. 40H—A combination catalog and "use-manual" covering a complete line of hydraulic jacks and tools. Blackhawk Manufacturing Company, Milwaukee, Wisc.

Boots Self-Locking Nuts—A nicely prepared 8-page catalog of Boots aircraft nuts of self-locking, wing, anchor, hexagon and bellows style. Scovill Manufacturing Company, Waterbury, Conn.

Turret Lathe Data Sheets—A series of loose leaf sheets giving valuable information on specific machining problems solved with special turret lathe tooling. Gisholt Machine Company, Madison, Wisc.

Arc Welding Electrode Chart—An attractive chart giving full data on thirty-six different arc welding electrodes. The Lincoln Electric Company, 12818 Coit Road, Cleveland, Ohio.

De-Ion Air Circuit Breaker Booklet—A 16-pg. two color illustrated booklet covering the entire line of Westinghouse air and compressed air circuit breakers ranging in capacity from 15 amperes up to 1,500,000 kva. Westinghouse Electric and Manufacturing Co., East Pittsburgh, Penna.

Speed—Vacation Number—One of the first and most attractive of airline vacation travel catalog, SPEED is a regular publication that will be sent on request. Western Air Express, 510 W. 6th St., Los Angeles, Calif.

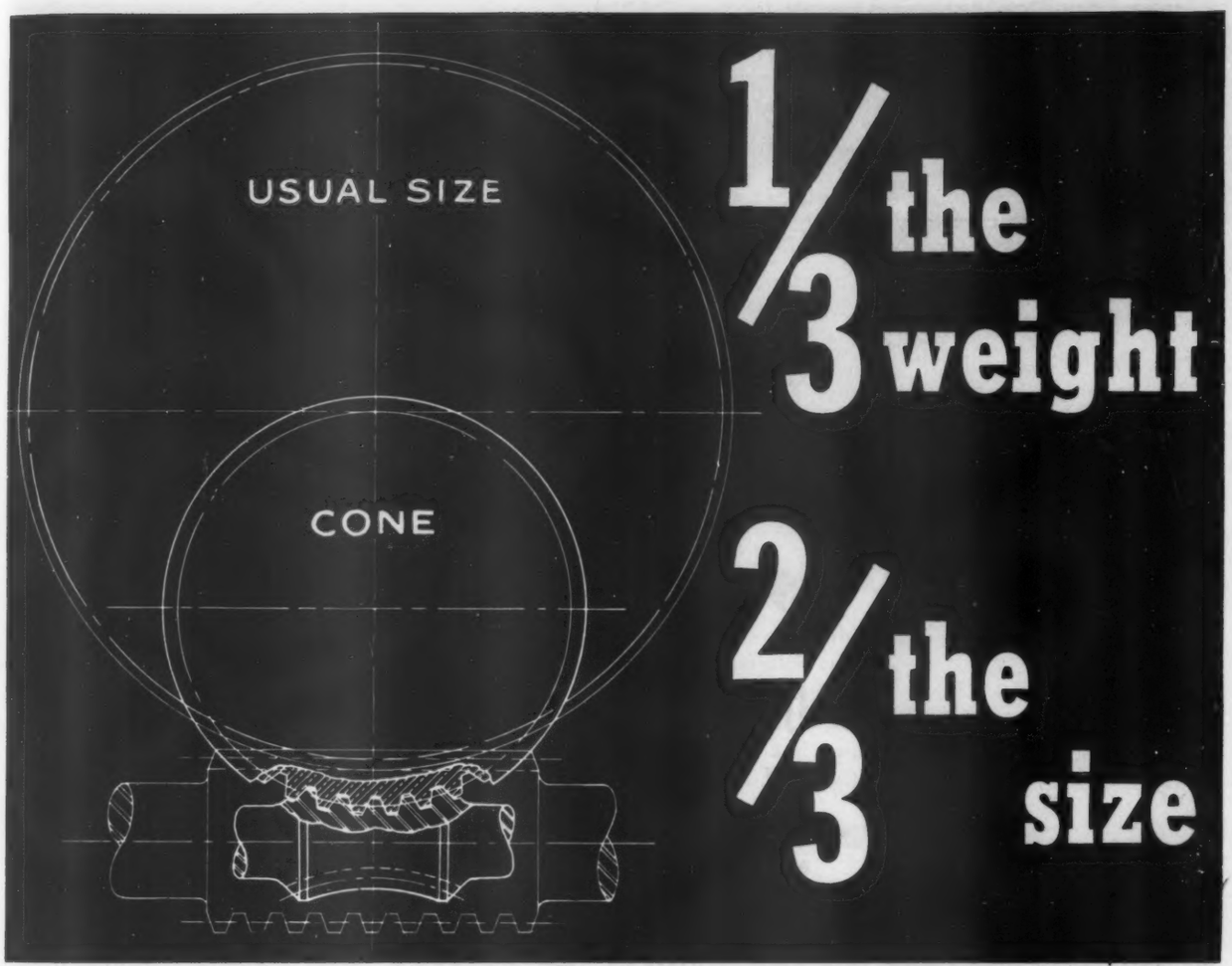
Cuprodine—Folder describes a process for copper-coating steel without use of electric current. American Chemical Paint Co., Ambler, Pa.

Precision Aircraft Forgings—A timely and well-illustrated folder on the technique of making aircraft forgings to meet present-day requirements. The Billings & Spencer Co., Hartford, Conn.

Boeing Four-engined Airplanes—A fascinating 8-page illustrated pamphlet dealing with the growth of the Boeing Aircraft Co. from the B & W two-place seaplane trainer of 1916 to the present Stratoliners and trans-oceanic Clippers. Boeing Aircraft Co., Seattle, Wash.

Dumore Precision Grinders—A 28-page catalog of the complete Dumore line of precision grinders.

Speaking of Endurance—A handsome 12-page catalog of Dumore fractional horsepower electric motors. The Dumore Co., Racine, Wis.



EVERY POUND of Cone-Drive gearing in an airplane represents a *Net Saving* of over two pounds in total weight.

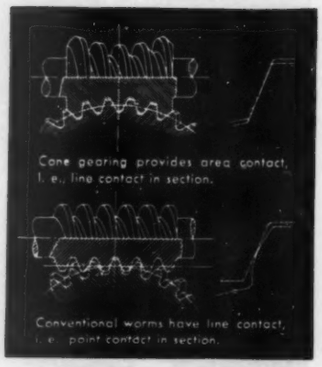
Compared with conventional gearing, Cone-Drive's exclusive double enveloping construction provides continuous area contact on from 3 to 7 teeth (depending on the particular gearset). In addition, the straight-sided tooth form of Cone-Drive gearing insures uniform tooth loading from tip to root with maximum tooth thickness and strength at the root.

The combination of these two exclusive advantages means that ⅓ smaller Cone-Drives do the work of conventional gearing weighing more than 3 times as much—aside from possible weight savings from smaller housings or brackets, design improvements, etc.

In hundreds of airplane installations over a period of 5 years—for retractable landing gears, aileron and flap controls, variable pitch propellors, machine gun elevating drives, synchronizer drives, etc.—there has been not one reported failure of Cone-Drive worm gearing.

OTHER CONE-DRIVE ADVANTAGES—

1. **Highest efficiency in the worm gear field.**
2. **Worm and wheel wear 'in'—not 'out'.**
3. **Exclusive meshing action squeezes lubricant 'in' instead of 'out'.**
4. **Positive self-locking action available when desired.**
5. **Less wear, longer life, due to lower unit pressures.**


Cone gearing provides area contact, i. e., line contact in section.
Conventional worms have line contact, i. e., point contact in section.

CURRENT CONE OPERATING RANGES
Ratios . . . Low, 1 to 6; High, 200 to 1.
Speed, Low, 1/15 rpm.; High, 30000 rpm.
Sizes (C.D.) Low, ⅝ in.; High, 27½ in.

If you do not know the complete technical story of Cone-Drive gearing, may we suggest you write or wire immediately for a copy of Technical manual No. 2235.

CONE WORM GEAR DIVISION

MICHIGAN TOOL COMPANY
7171 E. McNICHOLS ROAD, DETROIT

CECO

CARBURETORS

save weight

ONLY CECO can give NON-ICING, MANEUVERABILITY and INHERENT ALTITUDE COMPENSATION (Approx.) for both Wright Cyclone and Pratt & Whitney Twin Wasp at the characteristic low weight of the Chandler type.

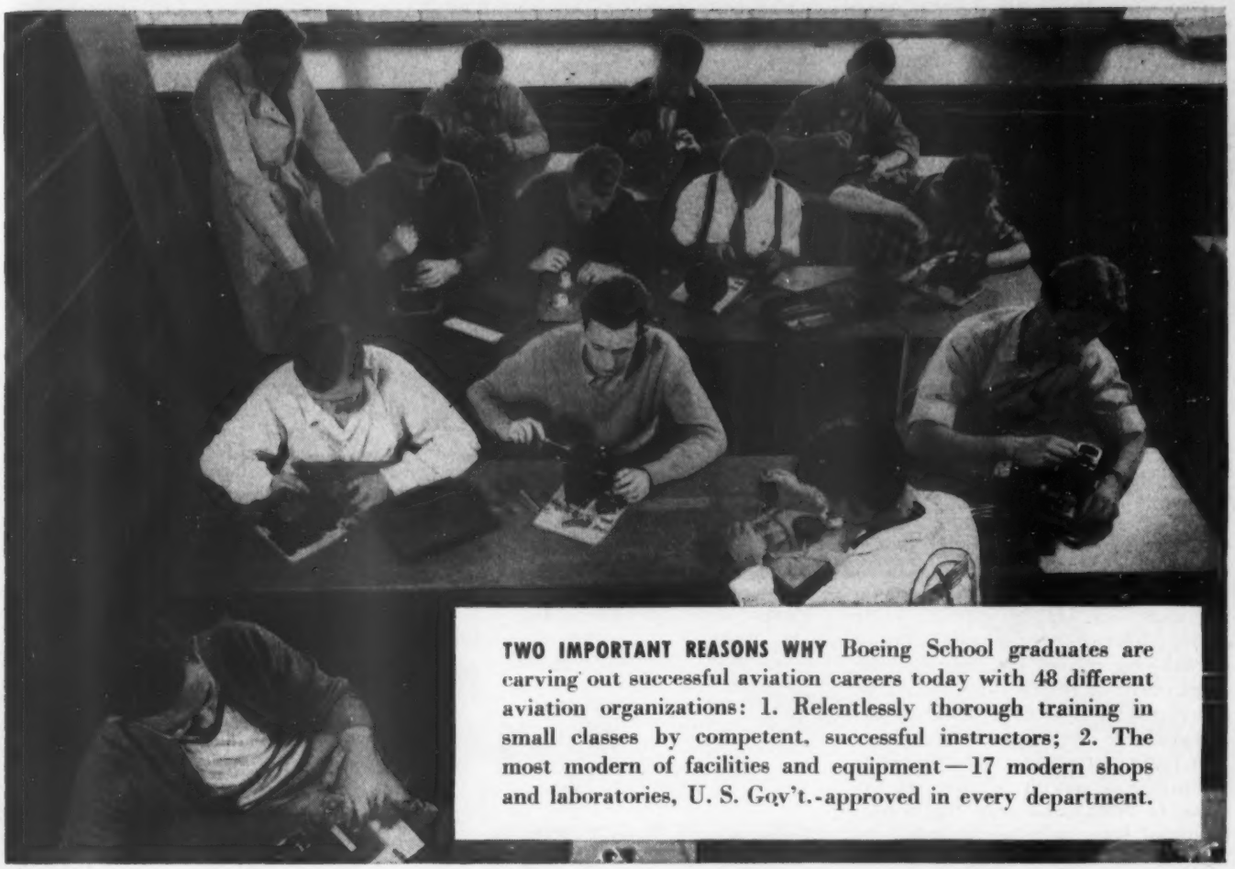
CE-1375-DA-1 for Cyclone . . 29 lbs.
CE-1375-DB-1 for Twin Wasp 32 lbs.

CECO fuel pumps approved by U. S. Army and Navy are in full production and available for early deliveries.

handler-evans-corporation

SOUTH MERIDEN CONNECTICUT U.S.A.

Cable Address: "Cheveco"



TWO IMPORTANT REASONS WHY Boeing School graduates are carving out successful aviation careers today with 48 different aviation organizations: 1. Relentlessly thorough training in small classes by competent, successful instructors; 2. The most modern of facilities and equipment—17 modern shops and laboratories, U. S. Gov't.-approved in every department.

If You Are A High School Graduate—

6 OF OUR 11 CAREER COURSES ARE OPEN TO YOU

Many young men may think of careers in aviation as limited only to flying. Others may be under the impression that modern aviation courses are open only to men with college training. Please note that Boeing School of Aeronautics—owned and operated by a major airline (United)—offers courses leading to 11 different aviation careers—and that 6 of these are open to high school graduates.

What are your qualifications? Which aviation career would you like? Compare your wishes and aspirations with the career courses on the coupon. Check the one, or ones, which interest you most and mail the coupon promptly as the first important step to your aviation career. *Boeing School graduates make good!*

ENROLLMENT PERIODS: JANUARY, APRIL, JULY, OCTOBER

11 CAREER COURSES One specially designed to fit your chosen field of aviation. Check the course or courses you are most interested in:

Courses requiring High School only

- ☐ Airline Pilot and Engineering
- ☐ Airline Operations and Engineering
- ☐ Airline Mechanic and Operations
- ☐ Aeronautical Engineering
- ☐ Airline Mechanic
- ☐ Aircraft Sheet Metal
- ☐ Private Pilot

Courses requiring 2 yrs. of college

- ☐ Air Transport Engineering
- ☐ Airline Pilot Course

Courses for engineering graduates only

- ☐ Airline Technician
- ☐ Airline Meteorology

Courses requiring special training

- ☐ Special Airline Pilot
- ☐ Instrument Rating

NOTE: Link trainer and modern multi-motor instruction available to students in all courses.

Boeing School of Aeronautics
1080, Hangar No. 5
Airport, Oakland, California.

GENTLEMEN: Please mail me—without charge—the Boeing School descriptive booklet containing complete information on the school and describing in detail the courses I have checked at the left.

Name .....

Street Address .....

City .....

State ..... *Age* .....

Previous Schooling .....

BOEING SCHOOL OF AERONAUTICS UNITED AIR LINES A DIVISION OF UNITED AIR LINES

Photographic Plane

(Continued from page 65)

heat intakes from the motor exhausts in the right and left walls and ceiling of the fuselage. Chest parachutes for each man are in convenient brackets.

Chief attention is directed to the tandem T3-A camera installation in the floor of the cabin and for which the door, with its movable, X-form arm guards is shown in the sketch on the right. Operating at an altitude of 20,000 feet these double 5-lens combinations—one component of which is turned at an angle of 45-degrees to the other—are able to photograph an area of approximately 24,600 square miles with a 60 per cent overlap in the direction of flight and about 30 per cent side lap between adjacent strips. Sketches to the upper left of the drawing convey the theory of the employment of the two units . . . as expressed with contact prints of the simultaneous exposures. However, in actual practice a secondary process is introduced. With reference to the plane of the ground only the central lenses of both units are parallel, the wing lenses being oblique. The final print, therefore, consists of a contact print from one of the central cameras and the wing prints are obtained by a "transformer" which projects the images of the wing cameras in such a manner that the correct perspective of the ground, with relation to that of the center camera, is achieved and in the ensuing combination of prints a true octagon is obtained without objectionable distortion of any of its parts. Differences in parallax at high altitudes are negligible.

The weight of the T3-A assembly with a full loading of film and camera accessories is about 360 pounds. Screws right and left of the cameras permit fore and aft levelling and the plane, itself, controls the lateral tilt. Vacuum is used to maintain flatness in the films and these are wound by the manually-operated handles seen projecting from the top sides of the central units.

Interstate Cadet

(Continued from page 77)

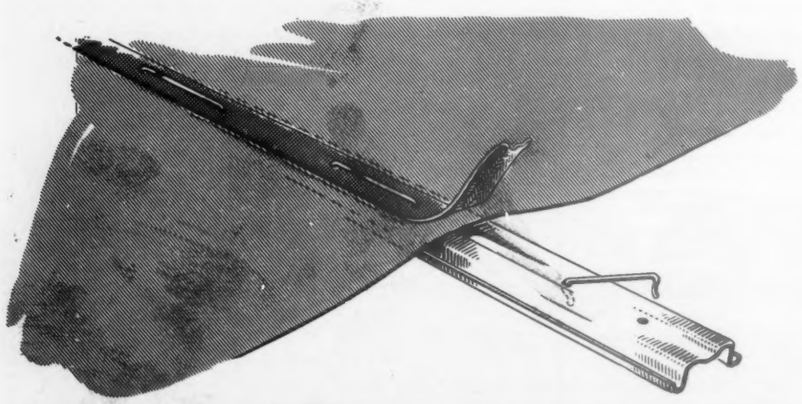
sion, Vultee Aircraft, is president of the company.

Specifications

Power	Continental 50 or 65 hp. engine
Wing area	173.8 sq. ft.
Fin area	4.75 sq. ft.
Rudder area	6.98 sq. ft.
Stabilizer area	13.02 sq. ft.
Elevator area	9.80 sq. ft.
Wing loading, gross	6.91 lb. sq. ft.
Power load'g, gross	18.47 lb. per hp. (22 lb. for 65 hp.)
Empty weight	675 lb.
Useful load	525 lb.
Payload—65 hp.	257 lb.,
50 hp.	257.5 lb.
Gross weight	1200 lb.

Performance

	65 hp. engine	50 hp. engine
Max. speed—sea level	114 m.p.h.	105 m.p.h.
Cruising speed—sea level	100 m.p.h.	95 m.p.h.
Landing speed	36 m.p.h.	34 m.p.h.
Service ceiling	15,000 ft.	13,000 ft.
Rate of climb	700 f.p.m.	500 f.p.m.
Cruising range	375 mi.	425 mi.



The fabric of the cadet is attached to the surfaces by means of a newly developed type of spring clip. By merely having to insert this clip into small holes in the structure the production time is reduced. Reduction of drag is also claimed.

Altschul

(Continued from page 59)

trend and begin to show an accelerated rate of profit gains.

As this is written the aircraft manufacturing industry, long subject to discriminatory profit limitations on domestic military business, felt a tightening of the screws with the recent modification of the Vinson-Trammell Act. As revised, this Act provides that aircraft builders and subcontractors with awards in excess of $25,000, shall be limited to a profit of 8 percent on competitive contracts, or 8.7 percent of the cost of performance, and on negotiated contracts to 7 percent, as against 12 percent previously. Since certain normal expenses have not been allowed in determining costs on government contracts, a limit of 8 percent probably means a maximum profit of 5 percent after all deductions.

Encouraging are the reports that the special profit limitations now imposed on the aircraft and naval construction industries may be but a passing fancy and repealed when the new excess profits tax is enacted. It is also hopeful that the question of amortizing industrial plants and equipment, built for the national defense program, would be greatly simplified.

It is felt that aircraft builders and shipyards are discriminated against because of the Vinson-Trammell Act. A uniform excess profits tax would place all manufacturers on an equal footing and remove inequalities.

The excess profits tax in effect during the World War was based on capital investment. Canada tried both the invested capital and average earnings bases in her excess profits tax levies, but found the invested capital theory too unwieldly and adopted the other plan. Although the average earning base method would obviously work a particular hardship on the aircraft industry, it is believed that if enacted, such a tax law may provide exemptions for the aircraft and other industries which have not attained stability of earnings in recent years.

Table I attempts to show the profits leading aircraft builders would have earned on invested capital last year, on the basis of a 5 percent profit on sales as compared with actual return on sales and invested capital. All this table purports to do is to present certain basic material which may be readily applied under various excess profits tax possibilities.

Flying IS BELIEVING

One cross country flight in this Howard for '40 is convincing evidence of its superiority in the air. It arrows through tough going like an Airliner and brings mental and physical relaxation which comes only from that feeling of "solidness" so typical of high wings and higher wing loading.

Once you learn from experience that you can have speed, excellent vision and comfort and this super-stability in flight WITH a landing characteristic which makes for the utmost safety, your choice will surely be a Howard.

Send for our catalog—the AIRCRAFTER—and ask for a DEMONSTRATION. Both furnished without obligation to interested people.

Features

5 people and 125 pounds of baggage can travel 1000 miles without refueling or overloading.

• • • • •

As fast as any plane in this price-power class, yet easy to land and ideal for taxiing.

• • • • •

Wings stressed to withstand loads 25% in excess of CAB requirements.

• • • • •

Exterior finish in high lustre "bird" colors. Interiors match the finest motor cars in motif.

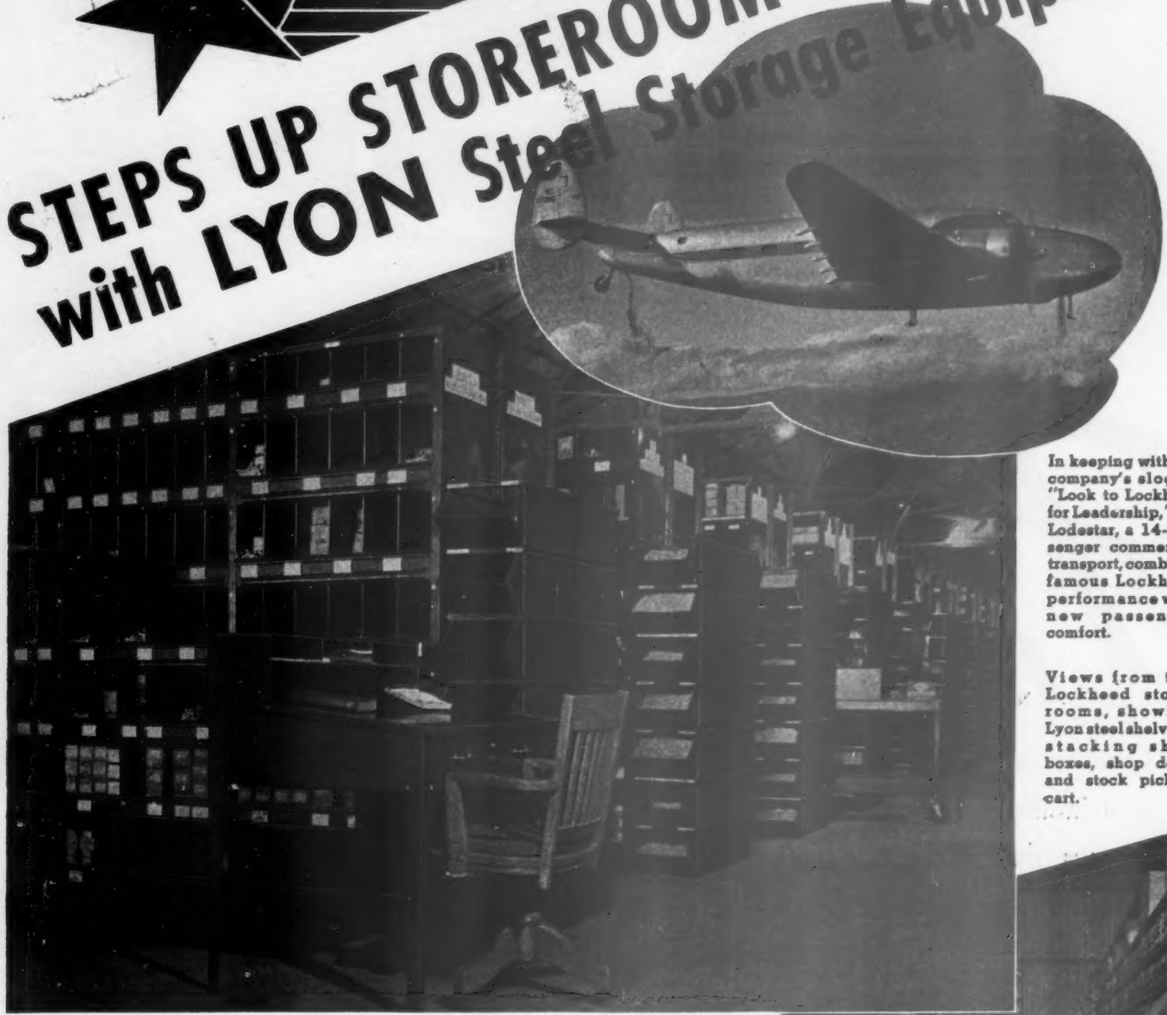
• • • • •

Maintenance problems reduced to the minimum because of simplicity in design and experienced workmanship.

Howard for 1940

LOCKHEED

STEPS UP STOREROOM EFFICIENCY with LYON Steel Storage Equipment

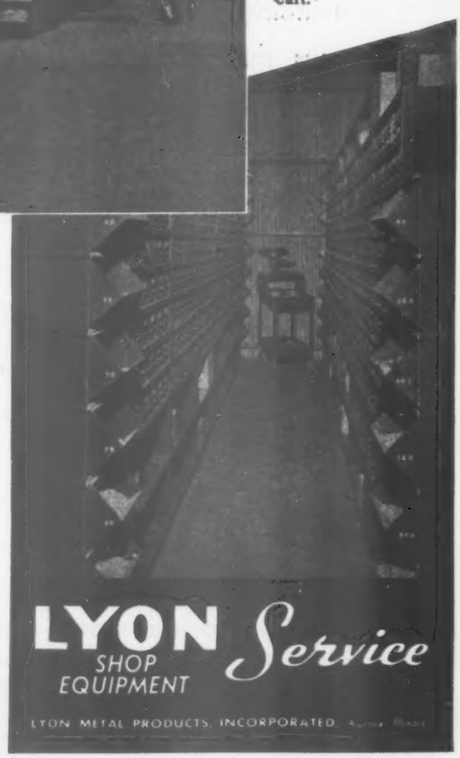


In keeping with the company's slogan, "Look to Lockheed for Leadership," the Lodestar, a 14-passenger commercial transport, combines famous Lockheed performance with new passenger comfort.

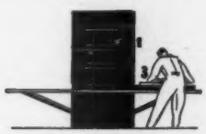
Views from two Lockheed stockrooms, showing Lyon steel shelving, stacking shop boxes, shop desk, and stock pickers cart.

● The influence upon production efficiency . . . the reduction of fire hazard, plus substantial savings in space and handling costs . . . stand out among the factors that make Lockheed Aircraft Corporation enthusiastic about Lyon Steel Shelving and Shop Equipment: Benches, Bar Racks, Stock Carts, Tool Cribs, etc.

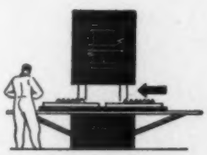
You, too, probably can use Lyon Steel Storage and Shop Equipment to save space and cut costs of handling materials in production or storage. Write for complete information on our industry-proved survey service. LYON METAL PRODUCTS, INCORPORATED, 5808 River Street, Aurora, Illinois.



1. Special metallurgical X-Ray tube, force-draft cooled, is in upper structure (1) shielded by 1800 lbs. of lead. Technician loads left side of double platform (2) with parts to be X-Rayed. Machine requires no special equipment ...plugs in ordinary current socket.



2. Loaded side has automatically moved under X-Ray tube. Shield lowers, and while exposure is made technician reloads opposite platform (3). This type of "production-line" testing enables Lockheed to accelerate manufacture with no sacrifice of safety vigilance.



3. Re-loaded side is moving into position for picture. Note that every operation of machine is automatic. The only equipment of its kind in the world. Designed, built and operated at Lockheed by Triplett & Barton Laboratories, Inc.

Lockheed X-Rays more parts than all other aviation manufacturers combined

They designate this machine only as "40-1"* at Lockheed. Yet it's a new, completely automatic X-Ray unit, the only one of its kind in the world. It's 20 times as fast and twice as accurate as any other comparable X-Ray equipment. Ten such units could photograph and assure the perfection of all the stress parts necessary for aviation's part in the National Defense Program.

* Patents Applied For

This safety vigilance *actually speeds up production* because it rejects any imperfect parts before they reach the production line, and assists in putting Lockheed in an advance position to meet present demands on the aviation industry.

Pioneered by Lockheed, and *constantly* expanded by Lockheed, this kind of engineering provides further assurance that you may safely...

LOOK TO *Lockheed* FOR LEADERSHIP

LOCKHEED AIRCRAFT CORPORATION • BURBANK, CALIF., U.S.A.

Now We Are In It

(*Continued from page 57*)

his aft gunner has been there to protect his tail against enemy craft which were either faster or came down on him from behind.

Here and there one came across a pilot and gunner who had worked out tactics for themselves so that when the pilot had done his best with his front guns, he manoeuvered to get in a secondary attack by his aft gunner. The Sopwith 1½ strutters and the Bristol Fighters, and to a certain extent the old R.E.8s, specialized on that form of combined fighting in the last war. But always the aft gunner was just the aft gunner, he was never the main attack.

In the Defiant the gunner, who has a four-gun turret, is the captain of the ship, the pilot, who has no guns in front, is just the pilot to put the ship where the captain tells him,—naturally a good crew so work together that the pilot will of his own accord bring his gunner into the best position.

But the chief feature of the Defiant is broadside attack. Hitherto there has been a belief that firing broadsides from machine-guns in high speed aeroplanes was useless. Obviously if a machine is flying or diving at 300 m.p.h., more or less, as a bullet leaves the muzzle of the gun it is hurled through the air sideways at the speed of the aeroplane, and bullets are not intended to travel sideways—30 m.p.h. if I remember rightly is 45 ft. per sec., so 300 m.p.h. is 450 ft. per sec., or 150 yd. a sec. sideways. And that does not make for good shooting.

A certain Dr. Magnus worked out theoretically, and some gunnery establishment in France at a place called Cazeau proved, that the spin of the bullet throws it up when fired on one side of the machine, and throws it down on the other. And the amount of throw up or down varies according to the speed of the machine. This is called the Magnus effect, or the Cazeau effect. And because of it no gun sights can be devised to give accurate shooting.

But what Dr. Magnus and Cazeau had not reckoned on was that guns which shoot at the rate of 1,200 shots a minute when firing four at a time tracer or incendiary bullets which leave a streak in the air, can be aimed as one aims a hose, and don't want any sights.

The result is that when the Defiants attack bombers the pilot dives outside the restricted arc of fire of the German guns, brings his machine alongside his victim, and the four guns just blast a hole in it.

Of course the Germans will, in due time, have power-driven turrets of their own. In the meantime we owe a debt of gratitude to Captain Archie Fraser Nash, the well-known racing motorist, late R.F.C. and R. A.F. in the last war, who invented the power-driven turret, and to Boulton Paul Aircraft, Ltd., who produced the particular variety of power-driven turret which they fit in their own machines and are being fitted in the Lockheed Hudsons. Meantime we have some quite nice new things of our own coming along.

At the moment of writing we are waiting to see what is going to happen next in this country. You of course have read all about our anti-parachute troops, made up of local people ranging from retired General Officers and Admirals, down through time-expired or maimed soldiers of the last war to farmers, farm-hands, professional men and so forth, all ready to repel parachutists.

In the Napoleonic Wars we built Martello towers along the Southeast Coast each within gun-range of the next, to repel Napoleon's armies at Boulogne. In the last war we barb-wired our East Coast and built concrete machine-gun emplacements against possible German landings as prophesied in that brilliant book the "Riddle of the Sands" written before 1914 by that patriotic Englishman Erskine Childers, who later went mad and became a Sinn Feiner and was shot as a rebel in Ireland.

Whether our "parashooters" will be any more useful remains to be seen. But we have to be prepared for death-or-glory squads of German parachutists landing on our aerodromes and destroying valuable aircraft, or alternatively landing near our aircraft factories and damaging them. Just how much more damage parachute squads could do than could be done by bombs is not clear.

One imagines that troop-carrying aeroplanes full of parachute troops would stand much less chance of getting through than bombers. And, although a certain number of bombers will always get through, especially if they come over in the dark in bad weather, flying blind through cloud, and take to indiscriminate bombing of the civil population they are still going to have heavy loss.

The Germans have always been bad psychologists. And even now they don't seem to have grasped the fact that the ordinary Englishman of Saxon origin, who is still the bulk of the population of this country, is slow to anger, but when he does become angry he becomes a very unpleasant person, and is difficult to stop.

We are just waiting to see what the Germans do. They may in accord with their threats, proceed to bomb our ports. The distance across England is so small that an hour's flying would cross it in its widest part. But even that means two hours flying over enemy territory, if the West Coast ports are to be attacked, with that much extra chance of being brought down by fighters or anti-aircraft guns, if the attackers start in bad weather hoping to catch us unawares and, as is quite likely, run into fine weather coming up from the West, as is its habit.

Indiscriminate night bombing will produce reprisals on a scale which the German High Command does not expect. Although Germany is such a big country compared with England, and although its munition industries are spread over a large area, yet one cannot assemble aeroplanes in small workshops whatever one may do by subcontracting bits and pieces. And we do know where the big German aircraft factories are,—as the result of training our bomber crews over Germany for about nine months.

By the way, you might do something, as the most influential as well as the oldest aeronautical journal in the United States, to stop the U. S. Press agencies from sending us here fool stories about Mr. Ford being ready to produce a thousand aeroplanes a day within six months of the word go. Perhaps you might discover who started the story and how he proposes to get instruments and armament and all the bits and pieces that go into a warplane.

Also you might explain to the good kind 600 private owners who, according to report, have offered to sell their private aeroplanes to us as training machines, that even in this country we realize that something like standardization of equipment is desirable, and that our Flying Training Schools are very nicely equipped with standardized trainers.